Petroleum Management

A PETROLEUM ENGINEER PUBLICATION October, 1961

USSR KEYS GROWTH TO GAS

Identify Your Shortcomings

Professionalism: Who's Right

Drilling Leaders Expect Upturn

Alaskan Line Conquers Crossing

Design Factors for Trays

What Drilling for Steam Teaches

Petrochem Feedstocks Shift

New System of Pipeline Controls

HURRICANE CARLA

Abrasijet...
a profitable way to complete a well

This cross-section illustration, as visualized by an engineer, shows a formation being notched with Abrasijet* — the Dowell-developed abrasive jetting service. The drawing was based on tests in which formation samples were notched with Abrasijet.

Notice the large surface area exposed by the notch. Notching with Abrasijet is an important starting point for recently-introduced frac design techniques. Abrasijet is also used for difficult perforating, vertical slotting of casing and cleaning open holes.

Results from hundreds of wells notched with Abrasijet and fractured by Dowell have been excellent, compared with similar wells fractured after perforating with explosives. Injection pressures required for fracturing have been lowered. Production increases have been outstanding. Gas/oil or water/oil ratios were improved. Occasionally, results from Abrasijet alone have been so good that fracturing was not required.

Ask your Dowell representative about Abrasijet. Dowell services and products are offered from more than 150 offices and stations in the United States, Canada, Venezuela, Argentina, Germany, France and the Sahara area. Dowell, Tulsa 1, Oklahoma.

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News

BOUGHT AND SOLD

Cities Service will acquire Columbian Carbon Co. under a proposed merger for a value of $108,000,000 in preferred stocks....Producing Properties acquired all oil and gas properties and acreage of Durbin Bond and Co., Dallas.... Ohio Oil purchased Petroleum Terminals, Inc., Chicago, a wholesaler....Ingram Oil and Refining has been merged with Murphy Corp. This adds 20,000 b/d refinery and marketing outlets to Murphy....Atlantic Refining has acquired a majority interest in the J. P. Frank Chemical and Plastic Corp., which has manufacturing facilities in Brooklyn....Joining Oct. 1 were Standard Oil Co. of California and Standard of Kentucky....Tex-Star Oil and Gas Corp. acquired majority interest in Heart of Texas Mining Corp. of Hurst, Tex., which produces sand used principally in fracturing treatment.

TO SPEND $1.9 BILLION

The nation's gas industry will spend $1.932 billion on construction in 1961, more than ever before in its history, according to American Gas Assn. A new peak was hit last year when $1.845 billion was spent by gas distribution and pipeline companies. Reflecting the continuing growth of the nation's sixth largest industry was the prediction by AGA that in the four-year period through 1964, construction expenditures would total $8.211 billion. From 1957 through 1960, they were $6.963 billion.

SETTLE PATENT SUIT

A three-year-old patent infringement suit between Du Pont Co. and Phillips Petroleum Co. has been settled with Du Pont dismissing its legal action against Phillips. The litigation was over a composition-of-matter patent on high density polyethylene.

CARLA'S DAMAGE

Texas-Louisiana offshore and coastal installations took Hurricane Carla's punch a lot better than expected. PETROLEUM ENGINEER Editor J. E. Kastrop, who flew over the area shortly after the hurricane, could see little structural damage to offshore facilities. The $8,000,000 Penrod Rig 52 mobil drilling barge was moved some 50 miles away by wind and waves. One inland barge rig was toppled over. Refining facilities were shut down from Port Arthur to Corpus Christi. It will be no small task to get all into operation again.

GIANT SNOWMELTER

Esso Research and Engineering has devised a snow remover that melts a 50-ton snow pile in 30 to 40 min. The machine is mounted on a trailer and snow is carried from front end loaders to a tank of heated, agitated water.

[News]

LUBE SALES UP

Sales of lubricating oils and greases were up 5.4% in 1960 over 1958, reveals a survey of the U. S. Bureau of Census under sponsorship of API. Of the 1960 total, 22% was sold for export, 2.3% to the federal government, and about 75% to the 50 states.

ADD PHYSICAL SCIENCES

Gulf Research and Development Company has formed a Physical Science Division at its main technical center at Harmarville, Pa. Comprised of 81 scientists, engineers and technicians, the new division will combine fundamental work in catalysis and nuclear radiation with other basic work. Dr. Norman D. Coggeshall is director.

O'BRIEN NAMED DIRECTOR

Jerome J. O'Brien of Midland, Tex., was named director of Department of Interior's Office of Oil and Gas by Secretary Udall. O'Brien has been vice president of the Monterey Division, Mid-Continent Region, Humble Oil and Refining. He succeeds Capt. Matthew V. Carson. O'Brien will serve under Assistant Secretary John M. Kelly.

UNION RE-ELECTS HEAD

Oil, Chemical and Atomic Workers International Union (AFL-CIO) re-elected O. A. Knight of Denver, Colo., president at the annual convention in Chicago last month. Secretary-Treasurer T. M. McCormick was also re-elected.

BEGINS URANIUM MILL

Petrotomics Company has begun construction of a 500-ton/day uranium mill and other facilities in Shirley Basin area, 60 miles south of Casper, Wyo. Stearns-Roger of Denver was awarded the contract to engineer and build the $2,000,000 mill, which will be completed in April 1962. Petrotomics is a partnership of Kerr-McGee, Skelly, Getty and Tidewater.

INVESTIGATION LAUNCHED

The Senate approved a special national fuels policy investigation Sept. 11. This move had been called for by National Coal Policy Conference, which stated the Senate action was "one of the most important and constructive that will be taken by the present Congress." Representatives of government and of the gas, oil, and coal industries will serve on the Senate committee. The coal industry hopes for tighter controls of residual fuel oil imports and prices set for natural gas sold to industrial consumers.

PUTS UP VENTURE CAPITAL

Creole Petroleum has formed an investment corporation to provide capital for local industries in Venezuela where the company operates. Creole is putting up $10,000,000 to start with and plans to expand. The idea is to offer this capital to private firms where needed for new ventures. Although Creole won't take a majority interest in any of them, the company expects to make money. Its chief aim, however, is to promote private enterprise in Venezuela.

News

NEW OIL CODE

The Republic of Niger has recently enacted a petroleum code which regulates exploration and exploitation in the country, according to a U. S. Embassy report from Niamey, the capital. Niger is south of Algeria and Libya, north of Nigeria.

PHILIPPINO SEARCH

American Asiatic Oil, Visayan Exploration and a new firm, Mobil Philippines Exploration, have entered a joint-venture agreement covering 62,000 acres in central Philippines. American Asiatic, which discovered oil on Cebu last May, will be operator in a search for oil and development on this concession. Mobil will be operator for other acreage covered by this agreement.

COLOMBIA GETS NEW FIELD

Colpet (Texaco-Mobil) discovered in August a new field in north Colombia. The 8000-ft wildcat flowed 348 b/d when completed. Located in the Cicuco field area, there are pipeline facilities to transport production to port of Covenas.

BRITISH MOBIL IS 75

In 1886 a group of Americans landed in Liverpool bringing wooden barrels of petroleum products from the Vacuum Oil refinery at Rochester, N. Y. Seventy-five years later Mobil Oil, Ltd., is still doing business. Under Chairman John C. Gridley, it operates 42,000 b/d Coryton refinery and a grease plant at Birkenhead; has terminals and bulk plants all over England.

ENI HELPS INDIA

The Italian oil entity, ENI, will provide a 12-year $120,000,000 credit to India for multi-purpose oil development. Tentative plans include: Construction of two product pipelines ($33,000,000), refinery ($33,000,000) and lubricants factory, gas separation plant, and petrochemical plant ($34,000,000).

STEEL CO. SUES UNION

A $5,500,000 damage suit has been filed against United Steelworkers (AFL-CIO) by Lone Star Steel Co. The petition, which seeks to recover losses alleged to have resulted from an illegal strike at the company's plant in 1957, was filed in Dallas at the U. S. district clerk's office Sept. 14. Despite a "no strike" clause in the contract at that time three-fourths of the Lone Star employees struck.

ARGENTINE OIL UP

Crude oil production in Argentina in the first five months of this year is 57.1% above that in the same period last year. Through May 1961, domestic wells produced 35,032,000 bbl compared to 22,295,000 bbl in 1960 period. The state oil agency, YPF, has awarded a concession to Ohio Oil Co. and Continental Oil Co. to explore and exploit 163,000 acres in Santiago del Estero Province and extending into Tucuman and Santa Fe Provinces.

Petroleum Management®

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Course of Oil

Subsidy, Anybody?

Instead of percentage depletion, our new Commissioner of Internal Revenue, Mortimer M. Caplin, wants the oil and gas industry to have subsidies "arranged on a year-to-year basis . . . if the industry is sick."

He doesn't spell out just how this subsidy is to be arranged. Nor who is going to decide the standards of health or sickness for the petroleum industry. Dr. Caplin? Dr. Udall? Dr. Kennedy?

We've had a mushrooming subsidy growth: Shipping, where it is supposed to ease competition between our inflation-generated labor costs and labor on foreign vessels . . . agriculture, where politics got a bear by the tail and can't let go . . . airlines, now enmeshed in controls and regulations that go with subsidy . . . power complexes, such as TVA, which give and give and get and get in a circle that can't quit.

How would you set up a subsidy plan for the U. S. petroleum industry? Would you pay a wildcatter not to search for oil or gas as you pay a farmer to limit his acreage? Or if gas were short and oil were surplus, pay him only when he found gas and fine him for an oil discovery? Would you pay a producer a stipulated amount for oil and store it until the tanks were overflowing then dump it on world markets until every oil-producing nation embargoed American goods? Would you pay a refiner to shut down part of his plant — the regulations (not efficiency) dictating which part?

This could become a subsidy to end all subsidies. It would require an outsize bureau in Washington perhaps headed by a newly created Energy Cabinet Secretary. Otherwise, who can decide if John Jones drilled within subsidy restrictions? And whether George Gillis can produce 16 or 106 barrels per month from old Stoneage No. 1 and still collect subsidy? When they took poor Abe Addison, an erstwhile refiner, to the state institution, he'd demand red tape three times a day. "It's my only diet," he'd yell.

Is oil and gas percentage depletion too simple? Before we kneel before more intriguing complexities, remember we have today a security in energy that no billion dollar a year subsidy could ever provide. Nor can the cost of subsidy be limited to taxpayers dollars. The greatest cost is concentrating the industry's management in the political center. To pay for subsidy we would exchange energetic competition that raises steps to climb on, and concrete dreams that allow a wildcatter to walk above failure, and justice that holds capital shall not be taxed.

And who subsidizes the subsidy? The government collects from you, then doles out a sum to you for running your business as it decrees. The dear old government is helping you out. That's the impression you're supposed to get. Actually YOU are subsidizing a new government bureau and you've surrendered some powers of management in the process.

There are nations today where subsidies cover every industry — but are we ready to follow their methods?

— *Ernestine Adams*

Congrats and $25.00 to Charles L. Mizer, 114 Lexington Ave., Taft, Calif.

Tough, tested and ready to roll . . . that's the story in a nutshell on Lone Star casing, tubing and line pipe. Tough, because it's made of quality steel by men who know the needs of the oil country. Tested so carefully that every length of pipe meets or exceeds API requirements before it leaves our plant. And because we're located in the heart of the Mid-Continent producing area, Lone Star pipe can usually be on-the-job at your well site overnight.

Men in the saddle in the oil business know that Lone Star pipe is *dependable.*

Neighbor, wherever you are, specify Lone Star and we both get a good deal.

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Profile

Paul G. Benedum

"The book is not closed. The responsibility is merely lessened and divided. It is nonetheless fearful. I hope that these loved ones of mine will bear with me in this last word of counsel, as I again remind them of the obligation that goes with their material heritage. I have unlimited confidence that they will be faithful to this trust." — From the last will and testament of Michael Late Benedum.

If Paul Gregory Benedum, nephew and principal beneficiary of the Great Wildcatter's large estate, has one goal in life, it is to measure up to his late uncle's faith. All of his diligent endeavors in the industrial, civic and cultural spheres are directed to that end.

From the moment of his uncle's passing, at the age of 90, on July 30, 1959, Paul has recognized that what he inherited was not so much material wealth as the responsibility of holding high the torch that was passed to him. While the world of petroleum recognizes the handsome, engaging and gregarious nephew of the Great Wildcatter as the active and controlling voice in all the Benedum companies, Paul himself looks upon these corporate entities primarily as vehicles to produce revenue for the Claude Worthington Benedum Foundation which he also heads.

While most of his friends regard Mr. Benedum's principal diversions as music and sailing (he plays banjo in a group of Pittsburgh musicians and sails off the west coast of Florida in winter), his closest associates know that he derives his most intense delight from looking over periodical reports on the grades of several hundred students who are beneficiaries of the Benedum Foundation's scholarship program.

Like his uncle, Paul Benedum is a native of West Virgina. It was in the town of Cameron, Marshall County, that he was born on February 17, 1902. He was graduated from high school there in 1921, and in 1927 received his BA degree from Ohio State University, where he majored in geology and metallurgical engineering.

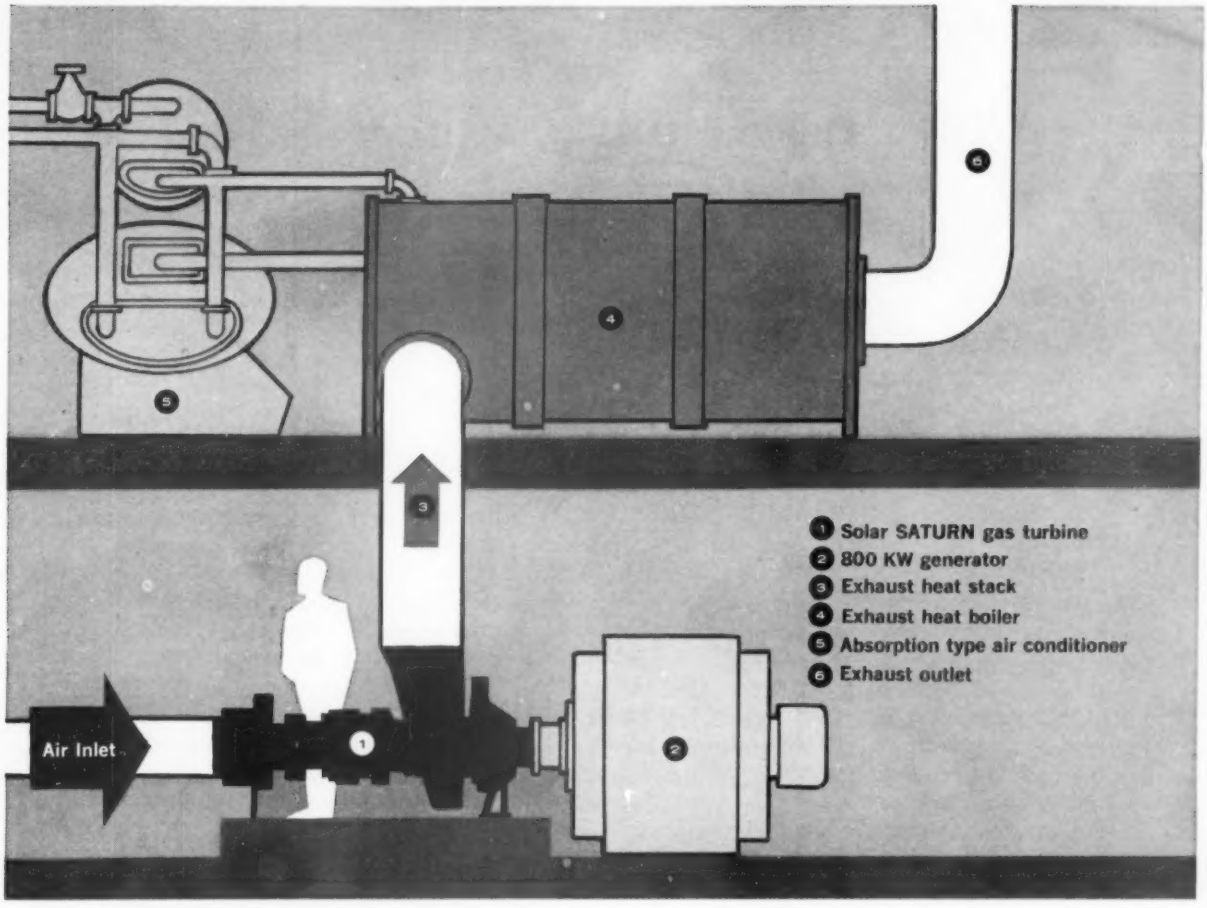
After leaving college, he joined his uncle's oil organization, and for 16 years roved the oil and gas regions of the United States as a geologist and executive of Benedum companies, and also headed a geological expedition to the Lake Van region of Turkey. He founded the Bentex Oil Company, of which he has been president since its organization in 1936. At the same time he served as president of Melba Mining Company, director of Plymouth Oil, Hiawatha Oil and Gas, and Penn-Ohio Gas.

In 1943 Mr. Benedum entered the service of his country, and as a lieutenant colonel in the Army Air Force was chief of the facilities and production section of the aviation petroleum branch. He was awarded the Legion of Merit for "performance of outstanding service."

Returning to the oil business after the end of the war, Mr. Benedum located in Pittsburgh and became president of Hiawatha and Penn-Ohio as well as vice president of Plymouth. When he recently became president and chief executive officer of Plymouth, he resigned as president of Hiawatha and Penn-Ohio, but remained as a member of their boards. He is vice president and a director of Republic Pipe Line and a director of Pittsburgh National Bank.

Mr. Benedum is also a member of the board of trustees of West Virginia Wesleyan College at Buckhannon, West Virginia; Waynesburg College in Waynesburg, Pennsylvania; and Shadyside Academy in Pittsburgh. He is a director of the Boys' Club of Pittsburgh, member of the executive board of the Boy Scouts, and a director of the Children's Hospital of Pittsburgh, the Western Pennsylvania Hospital, the Pittsburgh Symphony Society, and the Western Pennsylvania School for Blind Children. He holds honorary degrees from Capital University at Columbus, Ohio; Davis and Elkins College at Elkins, West Virginia; West Virginia Wesleyan College and Waynesburg College.

Mrs. Benedum is the former Beatrice Willeen Ludwig, member of a prominent family of Columbus, Ohio. They have one son, Paul G. Benedum, Jr., who, as an associate of his father, is vice president of Hiawatha and Penn-Ohio and active in other Benedum companies.



Solar gas turbine exhaust heat multiplies thermal efficiency

This unique system of efficient exhaust energy utilization illustrates one of the many advantages of Solar gas turbines. In addition to the turbine's main shaft power, exhaust gases can be put to work to multiply the thermal efficiency of the installation up to three times that of the prime mover alone.

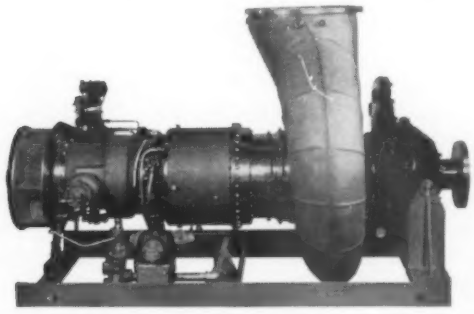
In the typical system illustrated above, Solar *Saturn* gas turbines turn 800 kw generators, providing electricity for lighting and machinery. Turbine exhaust heat is passed through a boiler to provide steam for process or building heat and absorption air conditioning.

This installation with three *Saturn* engines produces 2400 kw of electrical energy and 16,150 lbs of steam per hour. The complete package fits in a 60 ft by 40 ft space. The turbines will run on gasoline, kerosene, diesel fuel and natural or manufactured gas.

Exhaust heat utilization systems are easily adaptable to any job where electric power generation is needed, such as manufacturing and processing plants.

Solar gas turbines with their light weight, compactness, lack of vibration, long life and instant start capabilities are ideally suited for such jobs as electrical power generation, pumping, field and pipeline compression, oil well servicing, vehicle or marine propulsion.

Solar's family of gas turbines, from 50 to 1100 hp, are designed specifically for industrial use. Their design and manufacture are the result of over 15 years of experience. For further information, write to Dept. J-147, Solar Aircraft Company, San Diego 12, California.



SOLAR

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Conference Table

International Management Courses

Iranian Oil Operating Companies (The Consortium) reports that several members of the staff of the Operating Companies and of National Iranian Oil Company attended the advanced management course put on by Tehran University and Stanford University on the Caspian Coast. The course was enthusiastically received by those who participated.

Although management courses have taken on an international flavor, have gone into almost every country where oil companies have reached a certain size and integration, we still maintain that the real progress comes down to the individual. In this issue Mr. E. A. Neu gives the reader another valuable chapter in the "How to be a Manager" series with his practical advice in "Identify Your Shortcomings."

Business Education on Trial

The Committee for Economic Development has published a study of business education and how well it is set up to fill competently the management of U. S. business which is becoming increasingly complex. Based on two long studies supported by the Ford Foundation and Carnegie Corporation, the summary is written by Leonard S. Silk, senior editor of Business Week. Copies may be obtained from CED at 711 Fifth Avenue, New York 22, New York.

In the changing nature of business, the author says, "Rapid scientific and technological change requires a new and more professionally equipped group of managers — men with the technical background to communicate with scientists and engineers, to direct long-range planning, and to adjust all parts of a business to such revolutionary changes as automation and electronic data processing."

Fuel for New England

House Majority Leader John W. McCormack (D-Mass.) said that import quotas on fuel oil have cost the New England area alone more than $21 million a year in higher fuel and utility charges. He called for outright removal of controls on residual fuel oil imports saying they were a menace to New England industry, which was put at an unfair competitive disadvantage, solely because it must pay artificially high prices for the fuel it uses. He claims this, in turn, was a menace to jobs of thousands of workers in the New England area where substantial unemployment is worse than in any other region of the U. S.

SS Leaps Upward

In 1937 when Social Security was initiated, the combined employee-employer rate was 2% on a maximum of $3000 a year in earnings. Today the rate is 6% on $4800 a year. This is almost five times as much. The tax is scheduled to reach 9½% in 1969 without increased benefits. This is nearly 7½ times as much as when it began. If benefits are increased, the tax will have to be boosted still farther, and applied to higher income levels.

Who's to Blame for Oil Glut?

Why should the oil industry be criticized as if it alone is responsible for excess producing capacity? John P. Woods, director of Atlantic Refining Company's geophysical laboratory in Dallas discussed the international "oil glut" at Geophysical Service, Inc.'s student cooperative summer training program. He said, "Landowners and governments all over the world press upon the oil industry to generate for them that income which they consider appropriate.

Good Wells Make Good News

Recent Profitable Treatments Using Special Dowell Products and Services

October, 1961

While many oil and gas operators associate Dowell with stimulation and cementing services only, Dowell offers a wide variety of products and "auxiliary" services to help operators improve their wells. Here are four recent examples of Dowell products and "auxiliary" services in use:

- **Stonewall County, West Texas** (Old Oil Well) Scale buildup had shut off production from this well. Operator treated using 110 gallons Versene® 100 chelating agent mixed with 265 gallons fresh water. The solution was dumped down tubing with well dry, and rods were run in hole. Well was allowed to set for 24 hours, then Versene 100 was circulated with well pump for 48 hours. *Flush production after treatment was 60 bopd. After two weeks, production had leveled off at 17 to 22 bopd.*

- **Caddo County, Oklahoma** (Old Oil Well) This well was originally completed open hole. A gor of 2000 limited oil production to 90 bopd. Operator set liner and Dowell cut notch at 6020 feet using Abrasijet®. Well was then fractured by Dowell. *After treatment, well produced 200 bopd with a gor of only 150. Well was not producing at capacity. Operator attributes success of workover to single notch cut by Abrasijet.*

- **Kern County, California** (Old Oil Well) Production had declined due to a scale buildup in a 5½-inch, 80-mesh screen liner set from 3068 to 3131 feet. Plugging was nearly complete. Tubing weight could be set on top of scale buildup. Dowell cleaned by jetting 10,000 gallons three percent acid through a special jet gun with five downward-pointing nozzles. Injection rate was 4 bpm. Tubing was lowered at three feet per minute while jetting. *Production increased 86 percent after treatment.*

- **Wichita County, North Texas** (New Oil Well) This well was completed with open hole from 871 to 886 feet. It yielded only salt water despite the fact that apparent oil shows were encountered from 871 to 878 and from 881 to 886 feet. Further investigation revealed that upper sand was water and lower sand could not produce through mud block and head of water from upper zone. Dowell used Abrasijet at 883 feet and fractured. *After treatment, well produced 16 bopd allowable. Operator reports that economic loss was converted to profitable producer.*

Talk over your production problems with a Dowell representative. The chances are good that he has a service or product that can help you reduce your costs and increase your profits. Dowell services and products are offered in North and South America, Europe, North Africa and Iran. Dowell, Tulsa 14, Oklahoma.

SERVICES FOR THE OIL & GAS INDUSTRY DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY

If that income decreases, the pressure on the industry increases. It is all too easy to produce at too fast a rate, and all over the world there are various schemes to control rate of production.

"The oil industry eventually fears, not a glut of oil, but rather a lack of adequate reserves." Over the past 35 years, Woods pointed out, both reserves and production have increased at about 4% a year on the average in the United States, leaving this country's supply at about a constant 13 years."

Since 1945, he noted, domestic gas production has increased faster than reserve additions and supply has dwindled from 30 to 20 years. In a little while, he said, this supply will probably fall to 15 years. Gas exploration is losing the battle.

"It seems fantastic to look ahead and imagine the day when exploration will be required to find each year an amount of oil equal to known world reserves today.

"These demands will come when valuable men have left the industry and colleges have few geology and geophysics graduates. How can exploration possibly meet discovery needs of the future? This talk of glut is incredibly foolish."

Truck Facts Tremendous

Just released is "Motor Truck Facts," a report by Automobile Manufacturers Association. Here are some of the astounding figures that few people know:

Motor truck owners and operators in the U. S. paid a tax bill of about $3 billion in 1960.

Nearly 12 million commercial vehicles in the United States represents 42.2% of all the trucks in the world.

The 1,190,000 motor truck factory sales in 1960 were valued at $2,261,000,000.

Truck registrations in 1960 were 11,967,688 units.

What CEEPA Means

The new organization of state-owned petroleum companies called Conferencia de Empresas Estatales Petroleras de America (CEEPA) was purposely given that title to provide for subsequent entry of any possible state-owned petroleum companies of the USA or Canada.

The organizers may be more farsighted than at first realized. Certainly the United States has many state-owned businesses and industries. We also have a large element among our political leaders who would hail a state-owned oil company as a sign of progress.

"Let's Not Worry"

Are you a sucker for baby pictures with facetious captions? You can get a bookful of them in "Let's Not Worry — Let's Not Fuss — Let's Just Be Glad We're Us!". It's a rather long title and the idea is good.

Robert E. Moore decided no one was more objective than babies so his story is about a conference of babies solving world problems. Some problems are satiric: "Just leave your debt to us," a baby advises grown-ups.

Best part is Constance Bannister's photos — all babies with illusion of grown-ups' attitudes. (Published by A. C. Croft, Inc., Book Division, 1656 Lincoln Blvd., Santa Monica, California. $2.)

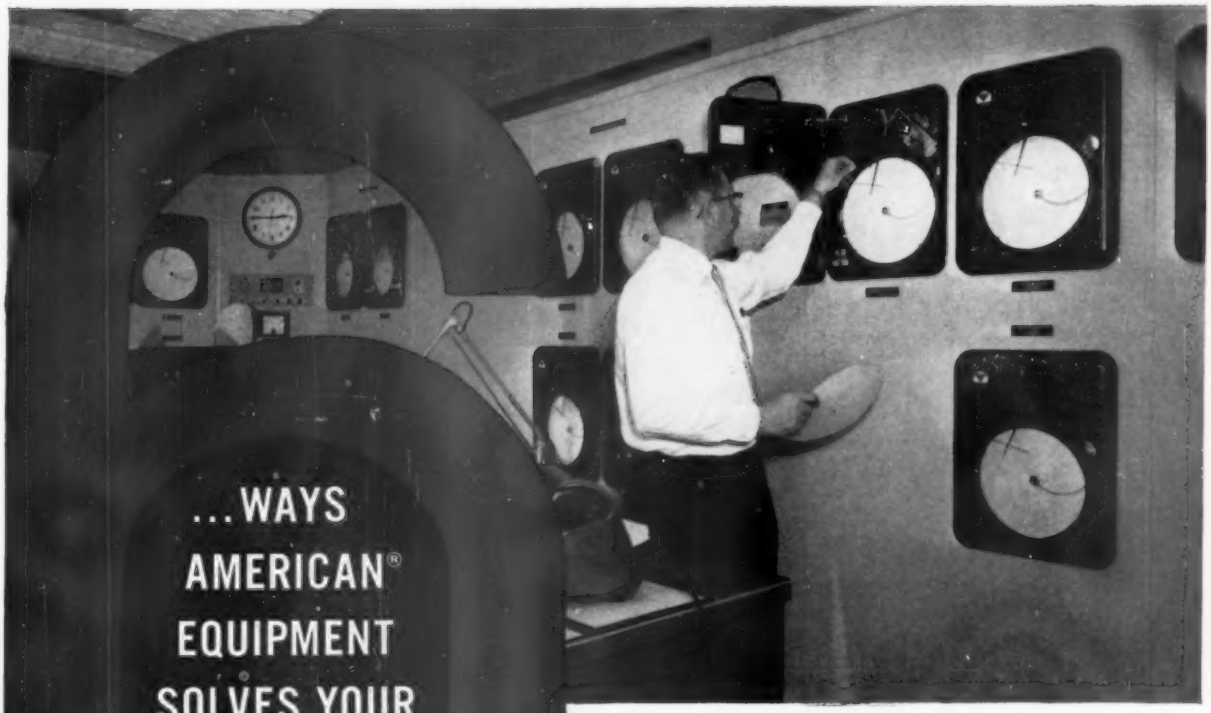
Coal Gets Government Aid

The first contract has been awarded by the Office of Coal Research in the USA Department of the Interior. It is for $139,000 with Booz-Allen and Hamilton of Chicago, and is directed primarily at stimulating demand for coal through the development of new products which are economically and technically marketable. More than 100 contract proposals are now being evaluated and additional contracts are expected to be issued soon.

So far as we know, the Federal Government has not been asked to underwrite research for increased use of oil and gas. We trust the industry will continue to be responsible for this factor.

A cynic is just a man who found out when he was about 10 that there wasn't any Santa Claus, and he's still upset. — James Gould Cozzens

An income tax form is like a laundry list — either way you lose your shirt. — Fred Allen



...WAYS AMERICAN® EQUIPMENT SOLVES YOUR MEASUREMENT AND CONTROL PROBLEMS

Whether your system is large or small, you can rely on American Meter's 125 years of engineering experience for the field-proven equipment you need for years of accurate, trouble-free measurement and control. Built to the highest standards of quality for sustained accuracy at lowest maintenance cost, American instrumentation reduces manpower requirements and provides continuous operating economies. Contact your nearest representative for complete details on how American equipment can build accuracy, dependability and economy into your system.

1 ORIFICE METERS

Dri-flo Orifice Meters in recording, indicating and integrating models assure maximum accuracy in differential pressure measurement.

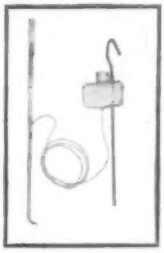
2 CONTROLLERS

Series A-88 Controllers accurately control continuous process variables.

3 GASCLOK POWER DRIVE

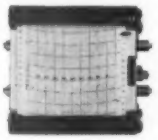
The ideal air or gas-operated instrument power drive and timing unit for remote installations.

4 CANNON METER PENS



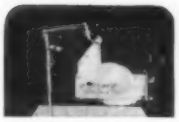
Controlled-flow meter pens prevent chart smearing and blurring. Record up to a year without refilling.

5 STRIP CHART RECORDER



Provides a long, unattended record with high resolution for accurate interpretation.

6 TELEMETERING SYSTEMS



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AMERICAN METER COMPANY

Changing Times

This issue marks the beginning of our 33rd year of publication. During these three decades plus, there have been many economic peaks and valleys in the oil industry. Always change, growth, and progress, whether in peace or war, in good or bad times. We strongly suspect the next 32 years will bring just as much, or more change to petroleum as we know it today.

As a mirror of the industry it serves, this publication also has changed. Letters coming in from readers from all geographical sections of the country indicate that you like our most recent change . . . our new look as of the August issue. We're happy you think The Engineer more attractive and easier to read. Your comments are sincerely appreciated and just the incentive our editors need to do an even better job.

A favorite expression of one of our friends is, "As long as we are green, we can grow." We intend to keep growing — and changing, as the need is indicated.

Joe B. Woods

PUBLISHER

Tough, colorful, lasting beauty!

Take those pumps and rigs in the oil fields—or those tanks and pipelines in the refineries! Each needs the tough, colorful, lasting beauty that Rust-Oleum provides. If the surface is rusty, Rust-Oleum 769 Damp-Proof Red Primer can be applied *right over the sound rusted surface* after removing rust scale and loose rust. Special Rust-Oleum Oil Field Finishes match the original equipment colors on pumps and rigs – while other long-lasting Rust-Oleum coatings protect costly tanks and pipe lines.

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"The new Slagen refinery—the largest investment ever made in Norway by an American company—is a milestone in the development of our business interests in Northern Europe. As Trygve Lie said at its dedication: 'Without technical knowledge and experience from abroad, Norway never would have had an oil refinery.' Slagen thus stands as an impressive example of the kind of international co-operation that strengthens free nations."

—M. J. Rathbone, President

Standard Oil Company (New Jersey)

(WHOSE PRINCIPAL U. S. OPERATING AFFILIATE IS HUMBLE OIL & REFINING COMPANY)

Take a tip from this contractor...

TRADE UP AND MAKE MORE PROFIT

New D6B Tractors do work 30% faster— cut fuel costs for Carl Rumage

Working in rain, this new D6B Tractor digs a salt water pit 40 ft. x 75 ft. x 10 ft. In spite of slippery ground and exceptionally tough, sticky soil, the tractor will finish the job in a single day. Mr. Rumage keeps his equipment moving — handles soil conservation work when not busy in the oil fields.

Like most contractors today, Carl Rumage, owner of C. A. Rumage Co., Vernon, Texas, is fighting the squeeze on profits every way he can. He's found one of the best ways is to trade up for new, more productive machines—even if existing equipment is working fine. Two new D6B Tractors, recently purchased by this contractor, provide a good example.

Comparing the new D6 with the old D6, Carl Rumage says, "Our new machines do the work at least 30% faster . . . and they do it on less fuel! Trading up to the new D6 is sure paying off for us."

There's good reason for Mr. Rumage's enthusiasm. The new 93 HP Cat D333 Diesel Engine, for example, has 25% more lugging ability than the previous model. A more comfortable operator's compartment and convenient controls help keep operator efficiency high. A new hydraulic bulldozer, with quick-drop valves, gives faster operation, increased productivity.

The new D6B helps keep down operating costs in several ways. Its easy-breathing Cat Engine can operate on high-energy, low-cost fuels such as No. 2 furnace oil. It has a dry-type air cleaner that eliminates the expense and bother of handling filter oil, can be serviced in five minutes, and keeps 99.8% of air-borne dirt out of the engine.

The long-life Caterpillar oil clutch usually gives up to 2000 hours of service before it even needs adjustment. Lifetime lubricated rollers that never need attention until rebuild time are a real convenience and save in maintenance costs.

Trading up to new, more productive D6B Tractors certainly made sense for Carl Rumage. A similar trade may help solve your profit problem. Your Caterpillar Dealer can help you decide and can demonstrate the production advantages of new Cat-built machines. See him today.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

CATERPILLAR

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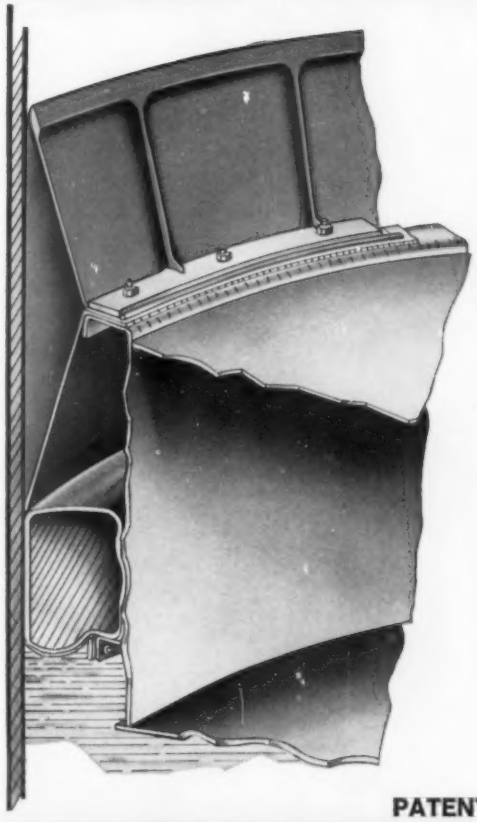
ALL FLOATING ROOF TANKS ARE FULLY EQUIPPED, **BUT...**

Only Tubeseal Has Lightning-Proof, Electro-Conductive Weather Shield



PATENTED

Tubeseal electro-conductive weather shields are an *exclusive tried and proved development*. They provide positive protection against lightning-caused rim fires. ■ How? By maintaining a *continuous* grounding bond between roof deck and shell—concentration of static charges is impossible. There has *never* been a lightning fire where any of the many hundreds of Tubeseal System Floating Roof Tanks are installed throughout the world—they're "lightning proof." ■ This is scientific and safe storage protection for the entire range of volatile products. Tubeseals can be installed on any of your tanks—new, old, riveted, or welded. You owe it to the future safety of your conservation facilities to investigate. Send for the Tubeseal Bulletin now—it could be important.

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The oilman paints a "dream" house – When the lady finally makes up her mind, she can be sure her choice is a good one. Solvents from petroleum will give her the paint job she wants, and keep her new home beautiful for years and years to come. Long-lasting finishes for home and industrial use represent another achievement of petroleum research – and another note of thanks the consumer owes to you, the oilman. If you hear someone criticizing oil, you've good reason to speak up in return. The thousands of products derived from petroleum are proof that you've helped to make it one of the world's most versatile natural resources.

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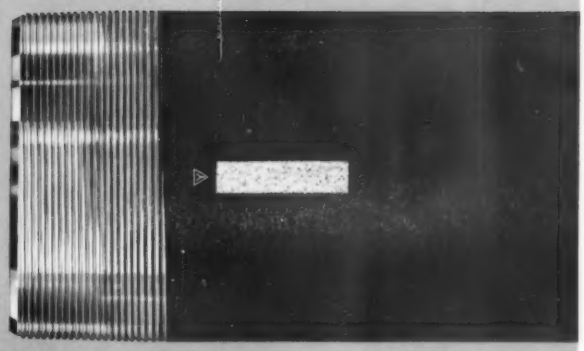

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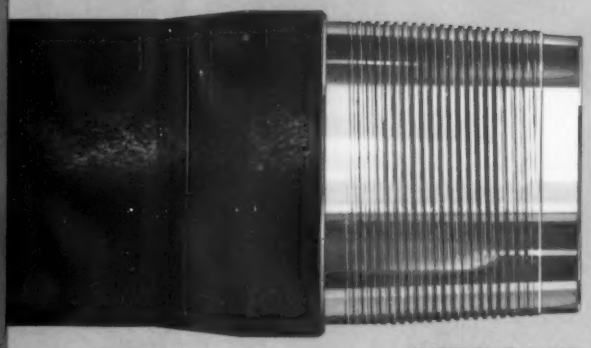

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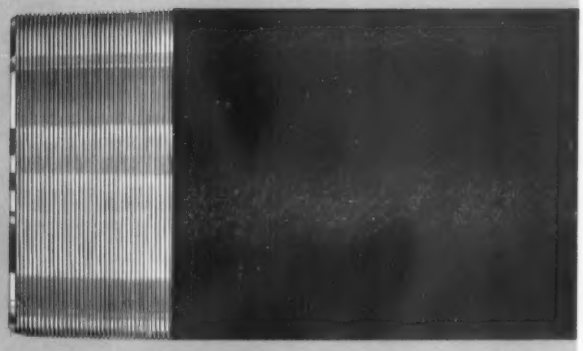

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Run quality Seamless with the Orange Band brand

Drill deep. Design your string. Match grade and weight with Orange Band casing from Youngstown. Get the quality and strength you need in every length for every depth, to meet tension, collapse and bursting loads. Quality Orange Band casing from Youngstown, makers of the world's most complete line of Oil Country Tubular Goods.

Get Youngstown seamless casing in all weights from 4½" through 13⅜" O.D. API (long or short) T&C in H-40, J-55, N-80, and P-110. Or specify Youngstown's Buttress T&C, Extreme Line and Speedtite integral joints in J-55, N-80 and P-110.

Youngstown casing is Youngstown-made from original ore to final, inspected pipe. Call on Youngstown for 24 hour service from intransit stocks . . . plus casing design service from Youngstown's field engineering staff, largest in the industry. Next string you run, depend on high quality Youngstown Seamless Orange Band casing.

Youngstown – growing force in steel

For details on all grades, weights of Youngstown Casing, write: Dept. 2D, **The Youngstown Sheet and Tube Company, Youngstown, Ohio.**

"MARSHALLOY"

–the one case good enough for *Mastergauge*

"CONOWELD"

one-piece tube and socket construction

Socket, tube—even end-piece—are actually fused into one piece by the Marsh "Conoweld" process. An instrument man described this integral socket and tube construction as the greatest recent advance in pressure gauge construction.

MASTERGAUGE MOVEMENT

Out of Marsh experience came the finer Mastergauge Movement—remarkably rugged, yet practically frictionless thanks to the alternate use of stainless steel and monel which gives it a self-lubricating effect. Note the coined (extruded) sector gear—a Marsh innovation. Its broad face contributes strength and precision.

Have you been reading those horror stories of "planned obsolescence", "pre-calculated service life" and other schemes for taking the buyer's shirt and pants? Then relax to the refreshing story of the Marsh Mastergauge—a product that has been planned and developed to outlast and out-perform anything like it ever made.

Mastergauge has always been the standard of comparison, but we have never let that fact lessen our efforts to make it still better. A good example of this is the "Marshalloy" case illustrated above.

Here is a steel case of boiler-plate thickness, heavily clad with copper inside and outside by the special "Marshalloy" process. It is one-third lighter than conventional cast iron cases and of course many times stronger. Yet it has the corrosion resistance of solid copper . . . and to make it still better a handsome black enamel finish has been developed to give it further corrosion resistance.

Yes, a case good enough to enclose the Mastergauge mechanism described opposite. Ask for catalog covering the Mastergauge and other Marsh Gauges.

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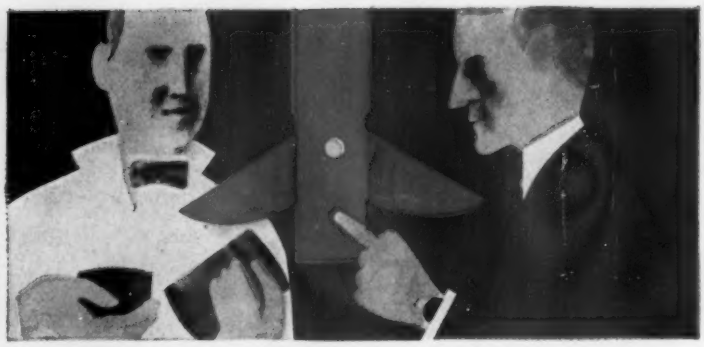
NEW UNDERGROUND SUPERHIGHWAY



Read how Gulf's Single-Point Entry Technique for fracturing gives up to 100 times the fracture capacity of conventional fracturing... offers you precision placement and increased drainage, too.

GULF

Perhaps you have used hydraulic fracturing successfully. It has helped many oilmen jump well production to 5 and 6 times the usual bbls./day.

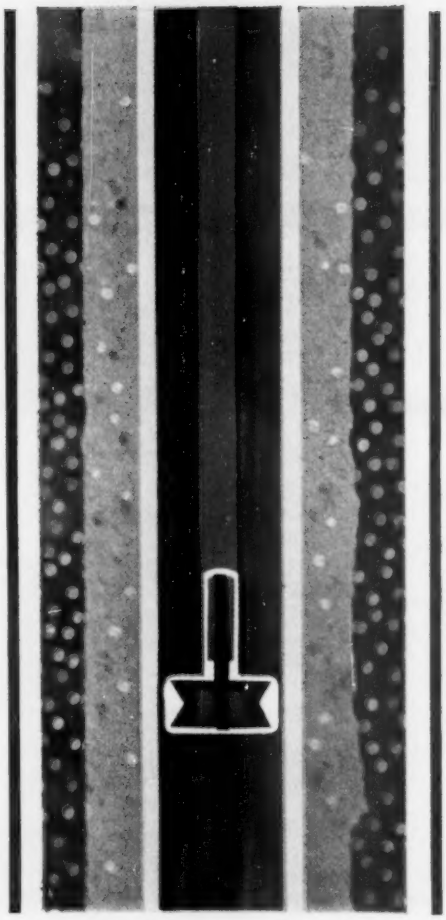
For a dozen years now, the basic technique of pumping fracturing fluids down the well bore under pressure to stimulate the flow of oil has been modified and improved.

But this conventional fracturing has its limitations. The industry has known this for a long time. At best, it is hit-or-miss. You can end up throwing several thousand dollars down a hole.

More often than not, you may be limiting your profits when your pay zone is thick or of low permeability.

It's also true that fracturing can give you disappointing results in a thin zone if the location of the fractures isn't right.

The scientific answer. Now, out of studies of fracturing at the Gulf Oil Corporation's Harmarville Research Center, comes an altogether new approach. One that all but takes the "miss" out of well stimulation.



For Gulf's development isn't just another technique. It is a precision system for fracturing. It replaces great gaps in our knowledge of fracturing with a painstakingly developed and tested body of scientific facts. It brings new ideas, new tools into play.

Our name for this precision system is Single-Point Entry Technique for fracturing.

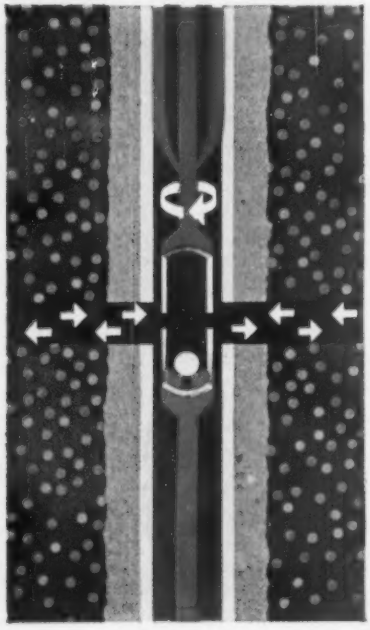
Up to 100 times the fracture capacity. Twenty-four service companies have already become Gulf licensees. In their hands, Single-Point Entry Technique for fracturing has already proved itself to be all our studies showed — and more.

One, it stimulates wells on jobs where conventional fracturing wouldn't even be worth a try. In itself, this characteristic moves

fracturing a long step ahead.

Two, Single-Point Entry Technique for fracturing usually outstimulates conventional fracturing techniques.

In both cases, Gulf's new system gives up to 100 times the fracture capacity of conventional fracturing. It has actually pushed productivity beyond the most hopeful expectations. In some cases, 20, 40, 60 times.



This system gives you all 3. Why does Gulf's new system give so much more than conventional fracturing? Because no conventional technique offers this scientific, systematic, 3-step approach: (1) precision fracture placement, (2) high fracture capacity and (3) an adequate reservoir drainage system.

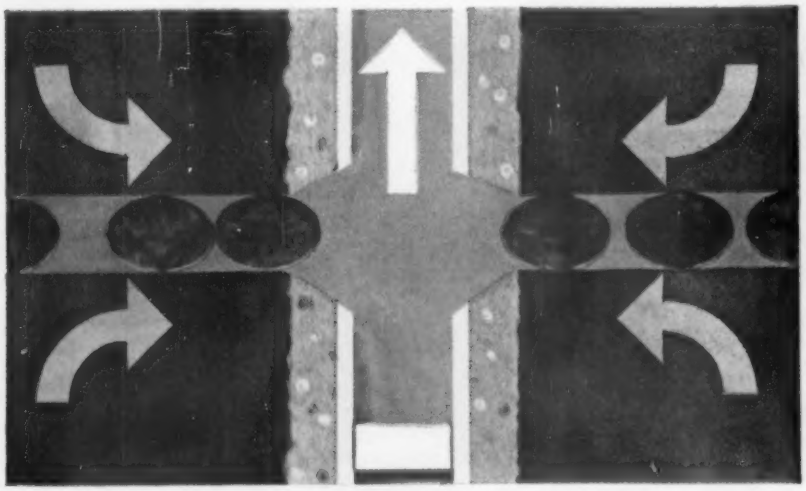
Now Single-Point Entry Technique for fracturing is available to boost your well flow levels. To pay you a sizeable number of bonus benefits as well. To improve reservoir drainage, for one. To lessen pressure drawdown. To lower gas-oil ratios. To minimize water coning. To make work-overs simpler.

"Superhighway" for oil. No more hope-for-the-best fracture location. In Single-Point Entry Technique for fracturing, any one of three tools cuts the notch precisely where reservoir study says it should.

These tools include a mechanical cutter, a hydraulic notcher which jets an abrasive stream, and a ring charge for use in explosive notching.

No more helter-skelter fractures with Single-Point Entry Technique for fracturing. In their place, a single large "superhighway," extended deep into your pay zone.

And no more inadequate drainage. Your large fracture area and carefully prescribed propping agents assure that.



Just contact these licensees. It's so easy to have the Single-Point Entry Technique for fracturing custom-fitted to your well-stimulation needs. Simply contact any one of these Gulf licensees:

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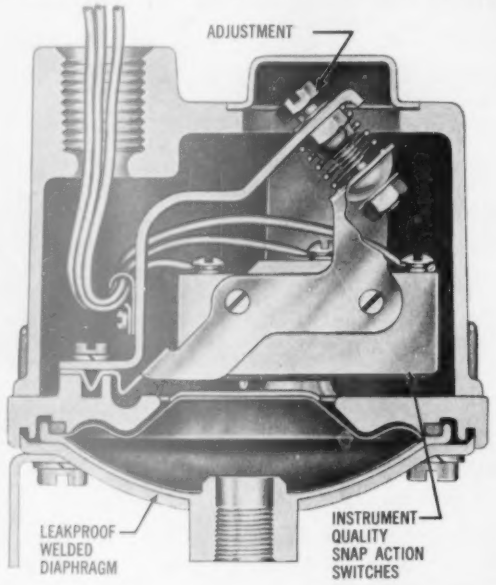
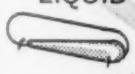
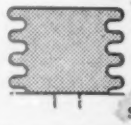
BREAKTHROUGH IN PRESSURE SWITCH ACCURACY

at reduced prices

The high accuracy associated with instruments costing several hundred dollars is now obtainable with new Barksdale pressure switches at a retail cost of $19.00 to $30.00. Accuracy of ± 1/2% is guaranteed and ±2/10% accuracy can be supplied when required. Substantial price reduction is accomplished by use of erector set design and a major investment in production tooling. A wide choice of "tailored to the job" features (see column at right) meets your specification requirements exactly.



THESE POINTS ARE IMPORTANT

WE BUILD IN	WE DON'T USE
EXTREME ACCURACY and DEPENDABILITY maintained during operating life due to direct acting design	**LINKAGES & BEARINGS** which, as they wear, make the setting of the pressure switch drift.
OPERATION IN ANY POSITION which saves the installation costs encountered in mounting a switch that uses liquid switching elements	 **LIQUID SWITCHING ELEMENTS** which make the switch difficult to mount and very critical to vibration.
IMMUNITY TO VIBRATION you can mount the switch directly on your vibrating or moving equipment.	 **ACCORDION BELLOWS** which make the pressure switch sensitive to vibration.

PRESSURE SWITCH DIVISION

Barksdale valves

5125 Alcoa Avenue, Los Angeles 58, California

New line of Barksdale pressure switches announced

Improved accuracy, reduced cost and higher proof pressures are advantages made possible by design innovations in the new Barksdale diaphragm pressure switches. Accuracy of ± ½% as compared to the customary ± 1% is guaranteed, and each unit is tested for repeat accuracy of set point and re-set point before shipment. Accuracies of ± 3/10% are available on request.

Erector set design offers dual benefit

The basic unit of all Barksdale diaphragm pressure switches is a diaphragm surrounded by a heavy protective capsule to which components may be attached as required. Addition of a switch, switch bracket and adjusting bracket to the basic unit makes a stripped switch for use in a common cabinet with other electrical devices. (Original equipment manufacturers need not pay for a housing which is not needed.) Addition of a sealed housing to the stripped switch completes a weather- and vapor-tight switch unit. A standard housing with integral terminal block or an explosion proof housing with integral terminal block may be specified. Erector set construction allows a wide choice in specifications that approximates a custom made switch and permits use of cost-cutting mass production methods that are reflected in lower prices.

Proof pressures to 300 psi

In the low settings the new Barksdale pressure switches will actuate at 0.1" mercury with proof pressure to 10 psi. In higher ranges they will go up to 300 psi proof pressure at settings to 150 psi.

Important additional advantages

Because the housings of Barksdale pressure switches are independent of the sensing and switching mechanisms changes in ambient temperature will not throw these switches out of adjustment.

The adjustment brackets are specially designed to protect switch terminals against shorting during adjustment.

Lead wires are held down by a tension clip. They cannot be pulled out accidentally and thereby throw off the switch adjustment.

Mounting brackets may be oriented in any of four directions.

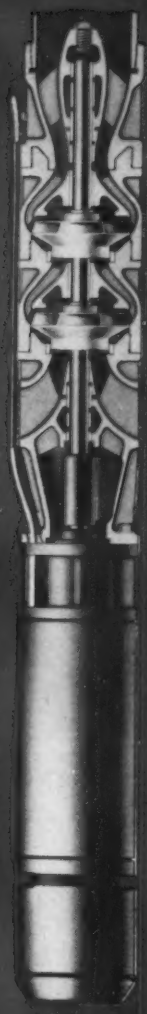
Tamper proof adjustment covers have servicing instructions on the inside to allow for painting of the units.

Standard pressure connection is ¼" npt female pipe fitting. One-half inch fittings suitable for mouting directly on ½" pipe can be supplied on request.

Standard housing has ½" nps conduit connections and a terminal block. The latter is accessible without removing the housing by lifting a cover plate.

Ask for new catalog and handbook

Complete details on Barksdale diaphragm, piston and bourdon tube pressure switches are included in a new catalog and handbook. This free book is a practical aid in planning the vital link between your electric and hydraulic circuits. It contains a glossary of terms, a schematic demonstration of operating characteristics, and a suggested step-by-step procedure for simplifying pressure switch selection. In addition, the book gives a complete run-down on all the detail features leading to the unit that answers your specific control problems. Send for your copy now, or ask your Barksdale representative.



Regular Submersible

SUBMERSIBLE PUMPS

deliver water

economically

consistently

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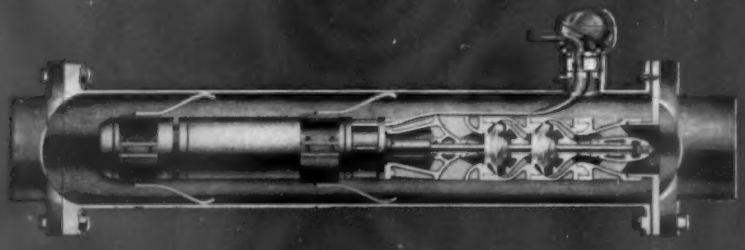
The Layne Submersible Pump installation gives you noise free operation because the pump and motor are completely submerged. The Layne Submersible is adaptable to all wells; requires a minimum of space since no pump house is required; eliminates possibility of water contamination; and eliminates the opportunity for vandalism or other accidental mishap or damage.

Layne Submersible Pumps are available for wells as small as 6 inches and in capacities from 30 GPM up. For additional information write for free bulletin number 202.

The Layne In-Line Submersible pump provides the answer to many problems in booster pump applications. The pump operates as an integral part of the line and is designed for use by municipalities, industry, such as petroleum and chemical plants and by agriculture. Advantages include: simple installation, no additional space required, continuous service even under flood conditions, and no possibility of surface water contamination.

Layne In-Line pumps are made as small as 4 inch bowls on a 4 inch motor for use in a 6 inch pipe to deliver 30 GPM. Larger sizes are available as required. For additional information write for free bulletin number 203.



In-Line Submersible

Layne SINCE 1882 — COMPLETE WATER SERVICE

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USSR Keys

How does the Soviet natural gas industry differ from that in the United States? That was the main interest for the eight American gas experts who visited the USSR recently under the 1959 agreement on scientific and cultural exchanges. The visit of the Soviet group to U. S. installations has been postponed.

Management

In the planning and execution of natural gas operations, the U. S. industry has thousands of producers, hundreds of pipeline companies, liquid gas processers, and distribution firms.

The entire Soviet natural gas industry is headed by a single agency, GLAVGAS. One of the U. S. group, Baxter Goodrich, senior vice president of Texas Eastern Transmission Corporation, explains that GLAVGAS works with the State Planning Committee, GOSPLAN, carrying out operations the latter decides upon.

"In GLAVGAS are Institutes, the medium through which plans and designs are formulated. The Institutes constitute a concentrated technical group of people to whom specific problems are assigned. This concentration is seen as having some appealing aspects compared with U. S. pipelining, where individual companies do independent work on problems common to all," said Goodrich.

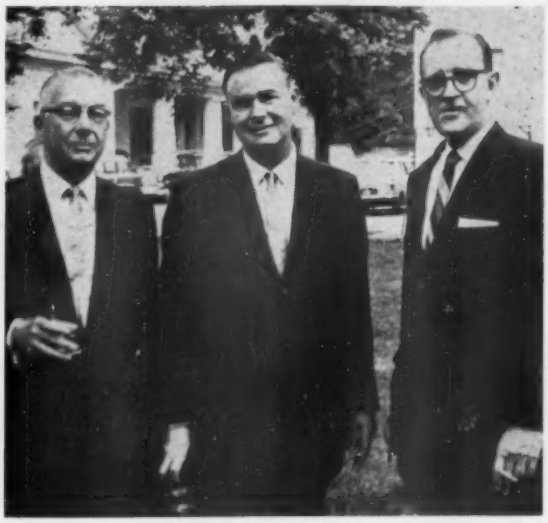
"Russia has a seven-year plan terminating in 1965, which has as its goals the laying of approximately 16,000 miles of pipelines and increasing gas production by 500%. Part of this program has been achieved or is underway. Accomplishments include discoveries of several gas fields and construction of pipelines."

Speaking generally on Soviet management, Paul W. Kraemer, vice president of Minneapolis Gas Company, said, "My opinion of the Soviet natural gas operations is the same as my opinion of practically anything that I observed in the USSR; the emphasis is not on the individual, but on economic power.

"The prime purpose in the development of gas reserves is for the benefit of industry. It seemed apparent to me that, since natural gas is the prime energy source, both as to utilization and to cost, it is a USSR necessity to devote all natural gas possible to supply industry."

Soviet planning in the gas industry drew this comment from William R. Connole, Washington lawyer and former FPC commissioner:

"Dominating all impressions of technical or engineering competence were economic and political impressions. Of course, this is not to say I was not deeply struck by the technical know-how of the Soviets. There is no mistaking skill and competence that can develop an industry from a poor last place as an energy source to a front runner, all within a space of a decade.



R. B. Stewart, H. A. Eddins, and Baxter D. Goodrich at an American Embassy reception in Moscow for the U. S. group of natural gas experts.

"I had expected to see this. But, what I saw and had not expected was significant.

"The Soviet energy economy is a powerful monolith. It moves ahead irresistibly once the political decision to emphasize it has been made. In 1955, natural gas met only 2.4% of the total primary energy needs of the Soviet Union. In 1965, it will supply 17.5%! Or, consider this comparison. Natural gas provided only 2.6% of the total fuel needs for electric generation in 1955. But, by 1965 it will supply 24.8%!"

Production and Reserves

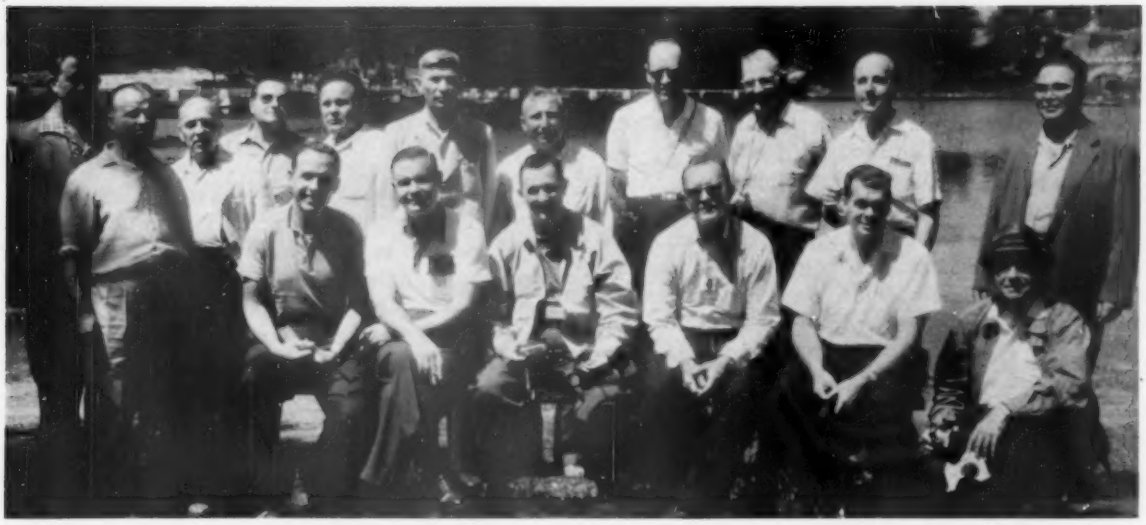
R. B. Stewart, vice president, natural gas, Phillips Petroleum Company, a member of the party visiting Russia, gives this summary of Soviet vs U. S. output and reserves:

"The Soviet gas industry is definitely in its infancy having produced only 1.66 trillion cubic feet in 1960 and with a planned production for 1965, the last year of the current seven-year plan, of only 5.3 trillion cubic feet. The United States, by comparison, was producing at the rate of 5 trillion per year by the end of 1946 from a proved reserve of over 160 trillion.

"The Russian's proved gas reserves are now

by Ernestine Adams

Industrial Growth to Gas



USA group and their Soviet guides. Seated are: Samuel J. Cunningham, H. A. Eddins, E. H. Smoker, B. D. Goodrich, Paul W. Kraemer, R. B. Stewart (in hat at right); beginning fourth from right in back are: Fred W. Batten; Hillis Lory (U. S. State Department) and Ed Wolsky (U. S. interpreter). Others are the Russian hosts.

only about 70 trillion cubic feet and their goal for the end of 1965 is 107 trillion. In order to reach this goal, they are going to have to increase their proved reserves an average of 10 to 12 trillion cubic feet per year. The United States annual increases since 1945 have varied from 10 to 24 trillion, bringing our proved reserves from 148 to 263 trillion cubic feet.

"To say that this industry is in its infancy is not to deny its potential. Actually, nearly all of the Soviet gas industry has developed in the postwar years, with the greatest emphasis developing in the last five or six. The discovery of the Krasnodar deposits and the huge Shebalinka field south of Karkov, as well as the completion of the first phase of the Stravropol-Moscow pipeline system, all occurred in 1956. Gazli field, the largest in the USSR, has been discovered since then. Natural gas is unquestionably going to play a major role in Russia's industrial and economic future."

Charles L. Adams gave an explanation for the laggard development of natural gas in an article in The Petroleum Engineer magazines (April, 1960, page E-2). Stalin's economic line held that development and use of coal should be given priority. GOSPLAN now admits that Stalin "permitted errors in determining the structure of the nation's fuel balance." It was not until Premier Khrushchev gained power that natural gas development became a major target.

Facilities

The U. S. group visited a 40-in. line under construction from Stavropol to Moscow, a distance of about 750 miles. Generally construction practices were similar to those in U. S., Goodrich said, and equipment looked familiar.

Largest proposed project is for dual 40-in. lines that will run from Gazli 1500 miles to industrial centers east of the Urals. This is shown on a map of Russian oil and gas lines in International Round-Up, Petroleum Engineer magazines (July, 1961, Page A-26.)

The 40-in. pipe comes from West Germany. Largest pipe fabricated in Russia is 28-in.

Largest U. S. pipeline is 36-in. This probably is the result of different companies transmitting gas to consuming areas.

"There is no target date for completion of any one project," Goodrich added. "Progress is geared to the dictum that every workman is allowed to work seven hours a day, six days a week throughout the year. If progress seems

to be too rapid, work is slowed down. The dual 40-in. lines are scheduled for 1965 completion."

Kraemer noticed the difference in approach on different facilities. He said, "The Soviet concept of gas energy for industry is evident in the machinery facilities and work methods devoted to the transmission of gas as opposed to the distribution of gas within cities for domestic users. It was obvious that a great amount of engineering and research has been and is being devoted to the moving of gas from the fields through the transmission systems. On the other hand, it appeared as though the construction in city distribution systems and the domestic appliances got the minimum of effort."

Samuel J. Cunningham, American Gas Association, senior research engineer, another member of the delegation, thought all Russian facilities were of a piece. "To begin with," he said, "the entire Soviet Union was very drab and there is an almost complete lack of the 'niceties.' This reflects in the Soviet gas industry because this area is also very colorless. The entire physical plant of the industry looks old and tired, although most of it is actually very new. Somewhere along the line the Russians have mastered the knack of using new materials to build old buildings.

"Equipment (compressors, valves, regulators) is either old or looks old. Many reciprocating compressors are old U. S. built models (lend-lease) or copies of the same. Centrifugal equipment is large (bulky) for its horsepower rating. We saw gas turbines being built that were rather primitive by our standards."

Natural Gasoline

With his background, Mr. Stewart's comments on LPG are of interest.

"I was surprised to find the natural gasoline industry as relatively small an operation as it is. The few gasoline plants presently operating are oil absorption plants processing casinghead only. These are located principally near the oil fields of the Ural-Volga region and in the Karadag area near Baku.

"The Russians are now building their first ammonia refrigeration plant in the Ural-Volga area near Mukhanova.

"There are no extraction plants on the large volumes from the prolific gas-producing areas of the North Causasus and the Ukraine Republic. They say they have two small oil absorption plants being built for casinghead gas in these areas, but the high-pressure gas well gas, which is very predominant in the Russian gas picture, is too lean for economical processing.

"In 1960 LPG production was 318,000 tons and it is expected to be 416,000 tons in 1961."

Storage

Russia's methods of producing and storing gas are perhaps 10 years behind those in the United States, President H. A. Eddins of the Oklahoma Natural Gas Company, Tulsa, said, "I'd say the Russians are about 10 years behind American methods — production, storage, etc."

Eddins said that while underground storage reservoirs such as his company maintains are fairly common in this country, so far as the party learned the Russians have only one, near Leningrad.

Distribution

The difference in who uses gas energy is pronounced. Consumption by individuals is low and the aim is for less in the USSR. According to Cunningham, "The Americans were told that at present 11% of gas produced is used for residential purposes and 89% for industry. Soviet spokesmen said that this ratio will change to 5% for domestic and 95% for industry in 1965."

In the U. S. a little more than half of U. S. gas is used by industry, while one-third goes to residential customers and the remainder to commercial and other consumers. It would seem from Russian figures that all home consumption of gas runs less than 500,000 mcf/d.

Eddins said that Soviet gas is distributed primarily for power plants and heavy industry.

"So far as distribution methods are concerned, it differs considerably from ours. They have no residential meters. They estimate over a period of time how much will be used for a house per person. They give them a booklet or coupons based on the number of people in the family, and they tear out one of those coupons every month and go down and pay one of the Russian banks for their gas bill. Industrial customers read their own meters and figure out the bill from that and pay accordingly."

Exports in the Future?

In 1960, U. S. produced 13.2 trillion cu ft of natural gas. The Soviet 1.66 trillion cu ft. In 1965, the U. S. is expected to produce about 16 trillion; Russia's target is 5.3 trillion.

None of the eight Americans voiced skepticism that the Soviet would reach its goal.

Connole warned: "It is plain that Western Europe must develop its indigenous natural gas supplies before Soviet domestic goals are met and a surplus is available for export. At present, USSR is straining to change from coal to an oil-and-gas-based energy economy.

"They have the will, the technical competence and, above all, the single-minded purpose

of a totally state-oriented industry. All they lack is time.

"Europe must develop its Sahara imports, its Lacq fields, its Groningen fields and establish a physical connection that will make it difficult if not impossible for Soviet gas to invade Western Europe. Then artificial price competition from a state economy will not be able to entangle Europe's increasingly oil-gas based economy in a net of Soviet pipelines built after her domestic needs have been met.

"The Soviet gas economy can and will do it because, primarily, it knows what it wants and where it is going. The Free World, and especially Western Europe, must make up its mind where it is going before too late."

This view was seconded by Cunningham, who said, "I believe the USSR may, at some early date, attempt to export gas to Europe and use this exported gas as an economic lever much as it is now using exported petroleum to shake that world market. If this does take place, watch for immediate progress within the industry. The current lack of compressors and pipe will become a thing of the past and gas production will be greatly increased to keep pace with increased oil production."

Stewart points out remindfully, "The Russians have no methods, techniques, or equipment in their gas operations that we do not use or have in the United States. They obviously have copied our methods and they study our literature diligently."

His comment is backed up by others in the group who found U. S. technical publications were translated and well studied.

Eddins said, "The Soviet natural gas operations are gaining in size rapidly. During the year 1960 they produced about 15% as much gas as was produced in the United States. In my opinion they will continue to discover substantial gas reserves and will continue expanding their gas operations at a rapid rate."

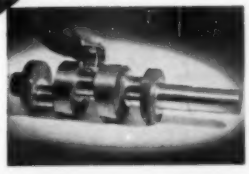
Eddins was of the opinion that if Russia developed more gas than needed to take care of Soviet needs, some satellite countries could expect gas pipelines to extend into their countries.

This sounds more reasonable than lines into Western Europe, unless world conditions change. Nations in Western Europe buy cheap Russian oil but they keep well hedged against stoppage with western contracts. Gas could be shutoff and energy starvation could be sudden.

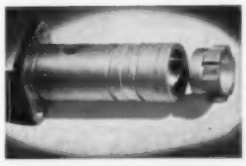
What did our U. S. group learn that is valuable information? Soviet gas industry is booming but this year is behind the Seven-Year Plan. Technically, the Soviet follows USA methods but personnel-wise it uses many more people, including women, and has complete disregard for safety. Differences between U.S. and Soviet industry are wide in volume and this will probably be true far in the future. ■

NEW! FRANK WHEATLEY'S P-200

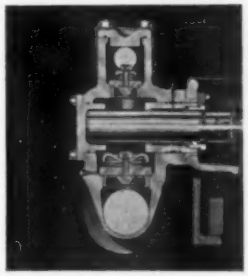
FRANK WHEATLEY'S P-200 is the product of customer demand for a P-175 "PLUS" . . . a greater volume pump with the same features as the economical P-175. The challenge was met and the result is a plunger pump with 20% more volume, perfect for packaged flood units due to its lightness and compactness. The 16 H.P. P-200 triplex, with 1⅛" — 1¾" x 2⅛" plungers, delivers volumes to 1,150 BPD with pressures to 1,760 PSI. All this — at no increase in cost.



The P-200 is equipped with Frank Wheatley's EXCLUSIVE Offset Crankshaft Design. This widely acclaimed feature results in a stronger, more compact pump.



The P-200 features still another Frank Wheatley EXCLUSIVE: Unitary Cylinder Heads and Stuffing Boxes for quick and easy maintenance in the field.



Large Suction, small discharge valves is another Frank Wheatley "FIRST". This EXCLUSIVE DESIGN FEATURE means more positive filling and faster valve action.

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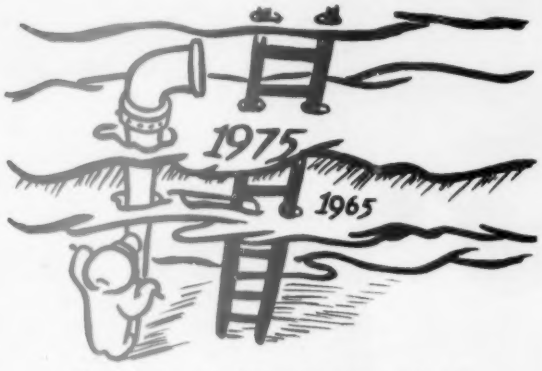
Identify Your Shortcomings

by E. A. Neu

At one time or another most of us have encountered situations in which our abilities fell short of the requirements of the moment. At such times our shortcomings were brought home to us rather forcibly. If we had been able to anticipate these situations in time, we might have spared ourselves through advance preparation



To prepare for '75, take a look ahead.

in the form of knowledge, training or experience.

This same principle applies to our personal progress in business. To a degree, our shortcomings can be anticipated and remedied.

Obviously, if the aspirant for the next step up the ladder is to succeed, he not only can but must anticipate and correct any serious shortcomings, because he must meet the requirements of the next step or fail in his objective.

There is a story about the expert from the Department of Agriculture who was endeavoring to give a farmer some advice on better farming methods. The farmer wasn't very much interested. His reply was, "Shucks, I'm not farming as well as I know how to now."

Aren't we somewhat like the farmer with respect to identifying our own shortcomings? If we take time out to look at ourselves objectively, we can doubtless think of a lot of things that we should be doing.

What then must one do to recognize his defects? First, let us ask ourselves:

1. Where do I want to be 5 or 10 or even 25 years from now?
2. What are the requirements of the position or positions for which I have ambitions?
3. What do I now lack to meet those requirements?
4. How can I acquire what I need?
5. What strengths do I now have that could be more fully utilized?

This sounds quite simple and logical, but it is the simple and logical that so often eludes us. Let us explore these five rather obvious questions, one at a time.

Have you ever seriously asked yourself: "Where do I want to be 5, 10, or even 25 years from now?"

It's easy and comfortable to drift along with the current, but it takes planning and aggressive action if you are to make the most of your abilities in the years ahead. The first thing you

"Train for advancement, prepare for emergencies and be ready for opportunities."
— Samuel M. Felton

must have is a goal, and the earlier in your career that you establish it the better. Until you know what you want, you can't plan on how to achieve it. So start by sizing up yourself and your interests, and decide on your goal for next year and the years ahead.

In so doing, take into consideration any past experience that may be of value, and base your objective on your real interests, — not just on monetary opportunities. If you are doing something you really like, chances are you will be successful at it.

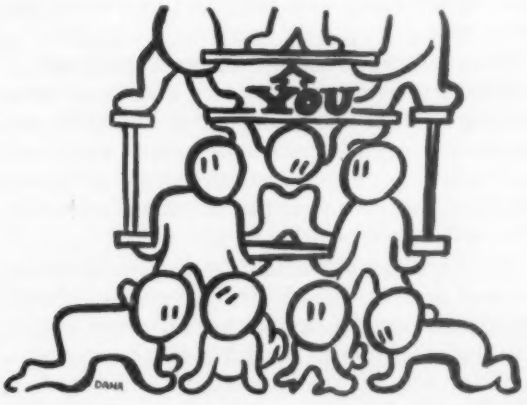
Are you in the right kind of work now? If you decide that you are not, the earlier you make a change the better it will be, both for you and for your company — whether it be a transfer to other activities in your present firm, or making an entirely new connection.

You may even decide that the managerial responsibilities concerned with directing the work of other people is just not your dish. Not every one is cut out to be a manager. Some are more valuable as individual contributors. It would be impossible, for example, to put a price tag on the contribution that Einstein, as an individual contributor, made to society.

Having decided upon your goals or objectives, then ask yourself: "What are the requirements of the position or positions for which I have ambitions?"

This is a question which, of course, cannot be dealt with in its particular, but the requirements of any position would normally fall into one or more of the following general categories:

(a) Managerial skills, such as planning, organizing, motivating people, and controlling results.
(b) Specialized knowledge, skills, education or experience which the position requires.
(c) Desirable personal characteristics—personality, tact, imagination, ingenuity, etc.



The higher you go the more people you depend on.

If there is any one denominator common to all managerial positions, it is the ability to organize and direct properly the activities of others. The higher one climbs up the managerial ladder, the more dependent he is upon getting his job done through the efforts of other people. This, therefore, is a most important requirement for any managerial job ahead.

Once you have charted the course you hope to follow, specialized knowledge, skills and experience should be fairly easy to identify. This is a matter in which your superiors can be of considerable assistance if you will request their help.

Concerning personal traits, there are, of course, some that are particularly valuable in specific jobs, such as personality and tact in dealing with the public. There is, however, no standard set of traits that will insure success as a manager. If you have any doubts about this, take a look at the many different personality types among the top executives in your own company.

Shop for good traits.

How many of today's personnel managers, do you suppose, would have hired young Abe Lincoln had he applied to them for employment? Very few, probably. Even if we could describe the "ideal package" of personal characteristics, it is not likely that we would be able to change ourselves to fit those specifications. About the best we can hope to do is to recognize any personal traits that may be of particular importance to us for our next step, and then try in every way possible to overcome any deficiencies we may now have.

In preparing for the job ahead, don't limit yourself to the present requirements. Think instead in terms of what they are likely to be 5 or 10 years from now.

The next question then becomes: "What do I now lack to meet those requirements?"

Two general conditions must be met before

you have much chance of being considered for promotion to a position of greater responsibility:

(a) Your superior who will make that decision must be convinced that you have the necessary capabilities. (And it's largely up to you to see that he is so convinced.)
(b) There must be someone available who is capable of taking over your present responsibilities so that you can be released. (If you don't have a subordinate properly developed you have no one to blame but yourself.)

To determine what you now lack, make an honest and objective self-appraisal. If you devote sufficient constructive thought to this, you are almost certain to recognize some ways in which you can improve your performance, and thereby increase your potential for the future. Most people are aware that they have certain shortcomings. For example, these may include such things as the inability to make a good speech, difficulty in dictating satisfactory letters, etc. But how many go beyond the stage of merely hoping that the boss doesn't know about their shortcomings, or won't find out about them?

Your boss probably has you figured.

In most cases your superior has your capabilities fairly well appraised. So why not have a heart-to-heart talk with him, and let him know you are interested in learning how you can do a better job. He can probably point out improvement needs that may stand in the way of your future advancement but of which you were not at all aware. Such a talk will probably also give him a somewhat better opinion of you as a potential candidate for future promotional opportunities. He is probably thinking about his next step, also, and he will want to be sure there is someone capable of stepping into his shoes when the time comes.

Also, there is a good possibility, in this enlightened age, that your company has a formal appraisal program to evaluate your present performance, your improvement needs, and your potential for advancement. If it does, you either have been told—or will be told—how you stand, and what you need to do to improve your performance.

This all leads to the question: "How can I acquire what I need?"

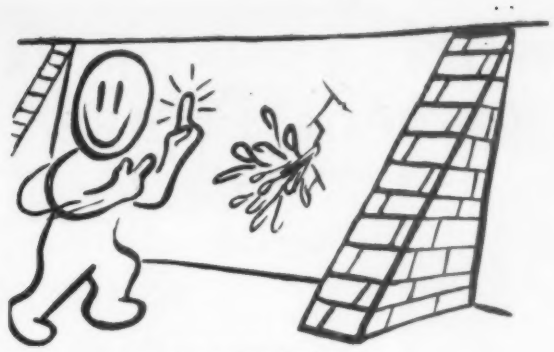
For one thing, keep foremost in your mind the fact that most development is self-development. You can't develop executives — you can only help executives to develop themselves. Unless you yourself have a sincere and compelling desire to improve your performance, and thus increase your potential for future advancement, your chances of succeeding in either will be very much impaired. Your company and your superiors can provide the climate and the opportunities, but only you can supply the driving force necessary for success.

Development is an individual matter. It must be tailored to fit your particular needs. Hopefully at this point — either by means of your own self-appraisal, a heart-to-heart talk with your boss, or through a formalized appraisal program — you now know what your improvement needs are. Also, hopefully, you and your boss by now will have outlined a program for your improvement. Above all, you must recognize that your success from this point on will depend on your acceptance of the need for improvement and on the efforts that you yourself put forth in seeing that the job gets done.

You should concentrate primarily on improving your performance in your present assignment and endeavor to handle it in every way to the best of your ability. Potential is difficult to measure, but one of the very best indications your boss will have concerning your future capabilities will be the manner in which you carry out your present responsibilities. Unless they are being handled in a commendable manner, you are not likely to be seriously considered for promotion.

Once you have started on your program of self-development, don't expect results to come overnight. Just keep working at it. There are, of course, serious limitations to how much you can control your own destiny, but conscientious efforts to improve your performance can hardly have other than positive results.

Most experts agree that by far the most important ingredient in improving one's performance, and one's potential for advancement, is day-to-day personal coaching on the job by a superior who has the interest and ability to help you develop. This is something you can't control.



Get ready for breaks.

But you can encourage such personal coaching from your superior through a proper attitude on your part and a sincere desire to develop to the best of your ability.

Despite the best of planning by all concerned, don't overlook the importance of "breaks" — being at the right place at the right time with the right experience. This you can't very well control, either, but if you see an opportunity in your area of interest, by all means try to make the most of it!

Finally, ask yourself: "What strengths do I now have that could be more fully utilized?"

Are you making the most of your assets? Do you have untapped abilities that could be put to use in better preparing for that "next step"?

Remember that you were undoubtedly hired in the first place because of your apparent strengths. These are the areas in which you have already developed interests or aptitudes. They are, therefore, also the areas where you are most likely to be able to further improve your performance.

If your company has a formal appraisal program, your strengths probably have been discussed with you during a post-appraisal interview. If it does not, this is a subject that you should discuss with your boss when you request an audience with him to find out how you are progressing and what you can do to improve your performance. And, of course, your own self-analysis should help to guide you.

Naturally, there are serious limitations on the extent to which you can control your own destiny. Therefore, we have tried to deal only with those areas where there are things you can do to at least help influence it.

It has been aptly said that there are three kinds of people:

(a) Those who watch things happen,
(b) Those who make things happen, and
(c) Those who don't know what's happening.

If you want to be ready for the next step, be sure you are one of those who make things happen!

Questions to Ask Yourself

1. Do you welcome additional responsibility and authority — or do you try to avoid it as far as possible?
2. Can you delegate work to subordinates — and then give them enough latitude to do the job, without excessive follow-up?
3. Do you ask subordinates for their ideas and opinions?
4. Are you a creative thinker?
5. Are you willing to try new ways of doing things?
6. When you go to your boss for a decision, do you make a recommendation—or simply refer the problem to him?
7. Can you change your position gracefully when the evidence shows you are wrong?
8. Do you postpone making decisions?
9. Do you have confidence in your own judgment?
10. Can you handle emergencies without becoming unduly disturbed?
11. Do your subordinates exhibit good teamwork?
12. Do you plan your work to achieve desired results, then follow through to see that activities are carried out in conformance to the plan?

Suggested Books

How Am I Doing, R. F. Moore
Applied Imagination, A. F. Osborn
Appraising Executive Performance, C. Heyel
The Uncommon Man, C. Greenwalt
The Technique of Handling People, D. A. Laird and E. C. Laird
How To Make Sense, Rudolf Flesch
Technique Of Clear Writing, R. Gunning
Are You Listening, R. C. Nichols and L. A. Stevens

The Author

E. A. Neu is director of employee relations for Texaco Inc., where he has been active in personnel and employee relations work for almost twenty years.

A native of Maryland, he was graduated from Johns Hopkins University in 1931 with a BE degree, and immediately thereafter went to work at Texaco's Port Arthur, Texas, refinery as a student engineer. After several years as an engineer, he was assigned to industrial relations work, and in 1946 was transferred to the company's West Tulsa refinery as supervisor of industrial relations.

Since 1953, Neu has served in various managerial positions in Texaco's employee and public relations department in New York City. ■

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Management People

George J. Hanks, South Penn Oil Company board member and executive committee chairman, and H. William Loveland, board member, retired. Hanks, former vice president and director of Tidewater Oil Company, resigned from this post to join South Penn Oil Company as executive vice president in 1944. He became president, was named board chairman and chief executive officer and held these offices until 1955 when he became president of the integrated company of South Penn and Pennzoil. Thomas O'D. Murray succeeded Hanks as chairman of the executive committee, and R. W. Grunert, senior vice president and board member replaced Loveland.

Joseph S. Badyk, former assistant secretary and treasurer of Canada-Cities Service Company, was assigned to head the newly formed natural gas and crude oil supply department for Canada-Cities Service Petroleum Corporation at Calgary, Alberta.

W. V. Coffey was promoted to the newly-created position of senior vice president and treasurer of Ambassador Oil Corporation. He has been vice president, treasurer and a director of the company since its formation in 1956.

Joel L. Carr, member of Atlantic Refining Company's legal department since 1959, was appointed general attorney. Harry W. Gill succeeded him as marketing attorney.

James W. Porter, Sun Oil Company, was appointed to the new post of manager, personnel development division, industrial relations department.

Hal P. Kibbey and James E. Nielson were appointed to the executive committee of Canadian Husky Oil Ltd. and Husky Oil Company. Kibbey is president of the company's subsidiary, Gate City Steel, Inc. and Nielson, son of Husky's president, is manager of the company's briquetting operation at Dickinson, North Dakota. Richmond M. Anderson, formerly with Hughes Tool Company, was named secretary and staff assistant to the president of Canadian Husky and Husky Oil.

M. J. Davis

C. E. Reistle, Jr.

Morgan J. Davis, Humble Oil & Refining Company, was elected to the recently created position of board chairman, and Carl E. Reistle Jr., former executive vice president succeeded him as president. Davis continues as the company's chief executive officer.

E. H. Styron, former employee relations manager for Mobil Oil Company's Houston exploration and producing division, was appointed manager of compensation in the employee relations department of Socony Mobil Oil Company, Inc. in New York.

E. H. Parker, Parker Engineering Company, was appointed sales engineering representative for the Burgess-Manning Company in Colorado, Wyoming and Utah.

Regnell C. Schaefer, former assistant director of the employee relations division, Texaco, Inc., was appointed director of the division.

John H. Thacher was appointed to a new executive assignment in the management of Standard Oil Company of California with responsibility over the company's interests in the Huntington Beach Company and the Elk Hills Naval Petroleum Reserve. He has held assignments as president of Iran California Oil

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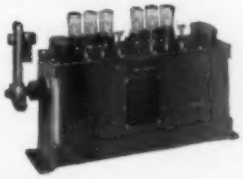

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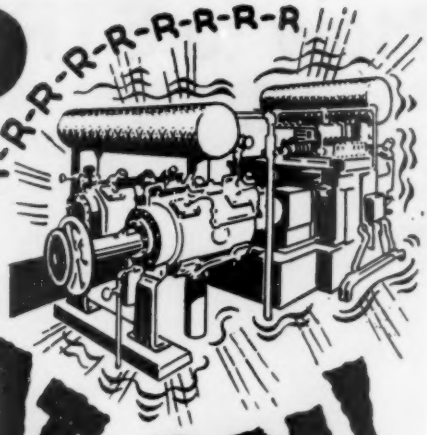

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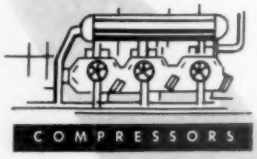

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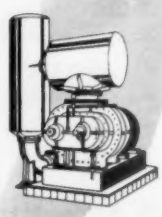

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Company and vice president and director of California Research Corporation.

Frederick W. Atherton joins Continental Oil Company in November to be concerned chiefly with analytical appraisal of company operations and projects. He is widely known in the oil industry as an authority on oil industry investments. In his new position, he will report to L. F. McCollum, president of the company.

Dan H. Sanders transferred to the company's international crude and products distribution department making his new headquarters in London, England.

F. W. Atherton

O. G. Schwenk

Otto G. Schwenk was elected president of the Dover Corporation succeeding Fred D. Durham who was named chairman of the board and who continues as chief executive officer. Before joining Dover, Schwenk was president and a director of the American-Saint Gobain Corporation, and its predecessor, the American Window Glass Company, Pittsburgh, Pennsylvania.

Dr. Eckart Edye, formerly deputy manager of the Esso refinery at Cologne, Germany, has taken over management of the Hamburg-Harburg Esso refinery as successor to Dr. Erhard Willig, retired.

Crown Central Petroleum Corporation named J. M. Bond general manager of supply and transportation.

R. W. Heath was named executive vice president of Signal Oil and Gas Company. He was vice president in charge of the gas department and a director since 1948, is vice president of the Natural Gasoline Association of America, and is a past president of the California Natural Gas Association.

Harold F. Clary was appointed senior vice president. He was formerly vice president in charge of the legal department. Charles Reid Gaylord resigned as director and senior vice president of the company.

B. B. Miller

Bert B. Miller, assistant to the president of The Ohio Oil Company since 1958, became company representative in Madrid, Spain. He is responsible for Ohio Oil interests in the construction and operation of a new refinery on the northern coast of Spain, as well as in possible future refining activities in Europe.

K. K. Harley, manager of the tax accounting division, retired after completing almost 31 years service. E. R. Krouse, former assistant manager of the tax accounting division, succeeded him as manager.

Michael L. Haider, former vice president and director of Standard Oil Company (New Jersey), was elected an executive vice president and member of the executive committee. He continues on the Jersey board with responsibility as a contact director in Latin America.

Mobil International announced appointments of key people in its four regional groups. They are: Earl A. Brown, regional vice president, and Jorge Mejia, regional executive — Latin America and Caribbean; Arthur L. Lanckton, regional vice president, and J. Byron Eckert, regional executive — Northern and Southeastern Europe; Curtis M. Klaerner, regional vice president, and Howard Bird Jr., regional executive — Inner Europe; and John C. Dean, regional vice president, and Alfred R. Tibor, regional executive — Mediterranean and West Africa.

Fred C. Boucke who has been serving in London as president of Iran California Oil Company, was appointed assistant to the chairman of the board of Standard Oil Company of California. He was succeeded by E. Perrin Fay, previously assistant manager of Standard's Eastern Hemisphere operations staff.

John R. Donnell, vice president of supply and transportation and member of the board of directors, The Ohio Oil Company, was named vice president in charge of all Ohio Oil international activities. He assumed broad new responsibilities for coordination of the company's exploration, production, transportation, refining and marketing activities over an area which already includes ten countries outside the U. S.

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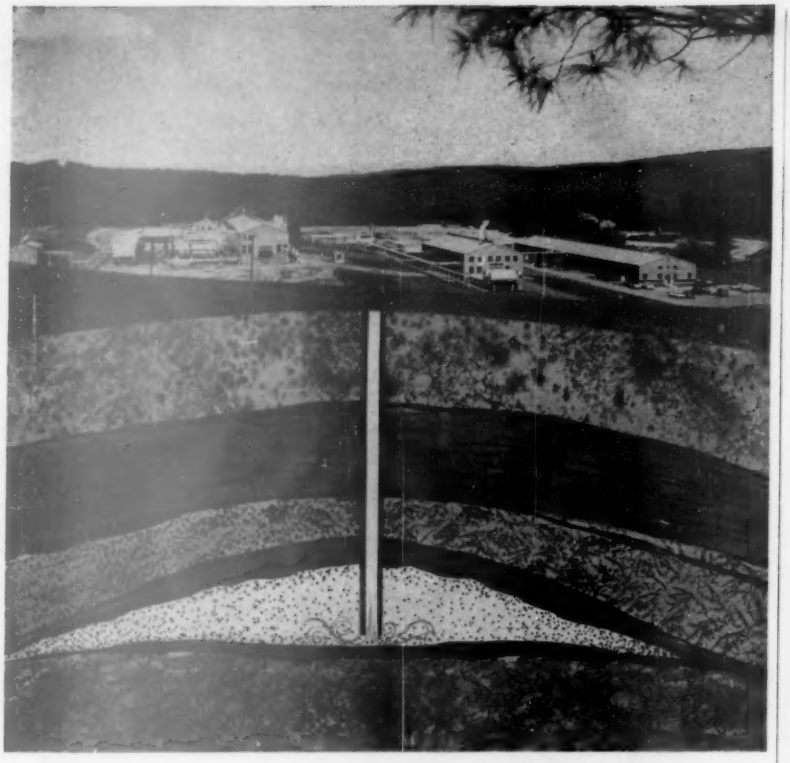

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"Do you keep stationery?" he asked the pretty girl behind the counter.
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Professionalism: Who's Right?

Engineers and managers agree it is important to have an accepted status of professionalism in their company. There is agreement, too, on the best means in working toward that end.

The tables at right show how similar are opinions of engineers and managers on what can be done to build professionalism. They also reveal wide discrepancies in beliefs of what is being done.

These tables are taken from "Engineering Professionalism in Industry," a survey for the Professional Engineers Conference Board for Industry in cooperation with the National Society of Professional Engineers (Published by Opinion Research, Research Park, Princeton, New Jersey. Price, $4.).

In the summary it is pointed out that in one set of companies (those credited with high engineering standards) only 41% of engineers feel their professional status is fully recognized. In more indifferent companies only 15% feel this way.

Scores over 50 are circled to show that engineers now feel they are doing the things they should to develop professionalism while managers do not think so. On the things companies can do, only a minority of engineers believe they are being done.

Results indicate engineers can best advance the cause by becoming better qualified. Besides technical education this means work attitudes, communications ability and integration with the company. Managers can help by giving engineers good work environment with proper recognition of achievement.

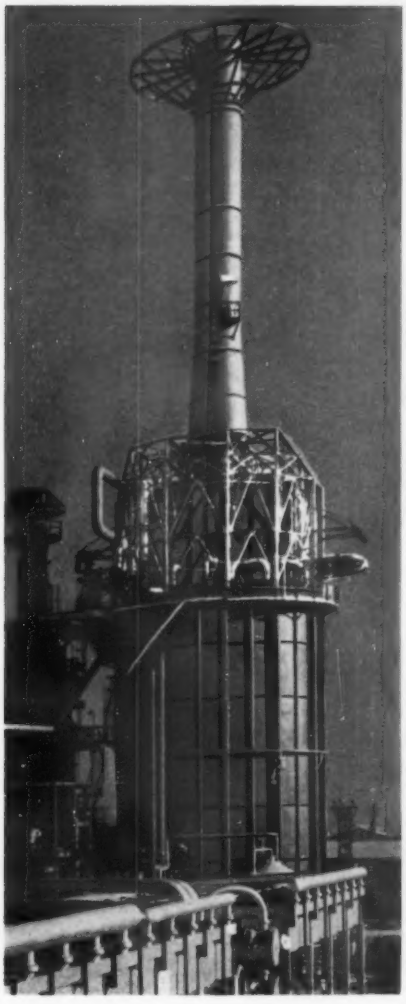
Both sides need to improve two-way communication. On the item that engineers should keep informed about other functions of the company, the difference of opinion is wide: 61% of engineers said they are now doing it, only 18% of the managers thought so. Then again 73% of the managers thought salary progression reflected engineers' contributions; only 23% of the engineers agreed. ■

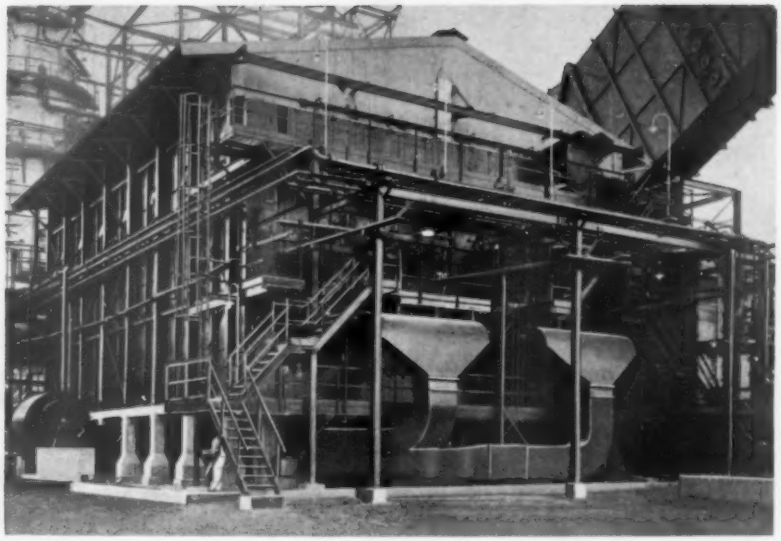
Things Engineers Can Do to Build Professionalism

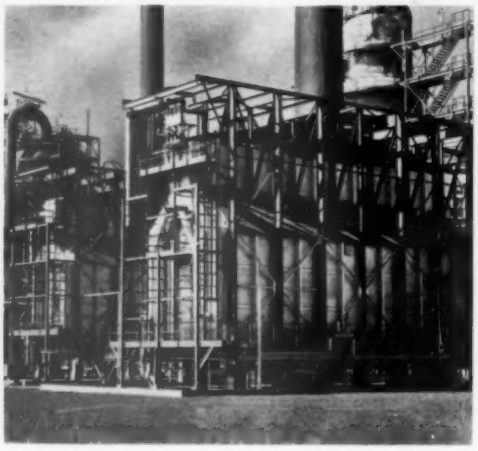
	Things that Engineers Say:		Things that Managers Say:	
	Are Very Important to Do	They Are Now Doing	Are Very Important to Do	Engineers Are Now Doing
1. Develop communications skills	(74%)	(72%)	(78%)	22%
2. Seek further education	(66)	(60)	44	31
3. Learn business objectives of projects they are working on	(59)	(73)	(67)	33
4. Use channels of communications with management	(59)	(60)	(69)	33
5. Discuss any problems of professional status with managers	(56)	31	42	27
6. Keep informed on business conditions affecting the company	47	(67)	47	20
7. Identify with goals of the company as a whole	45	(60)	(56)	29
8. Keep informed about other functions in the company	38	(61)	38	18
9. Investigate economic factors top management must consider	38	35	36	7
10. Belong to professional or technical societies	36	(72)	47	49

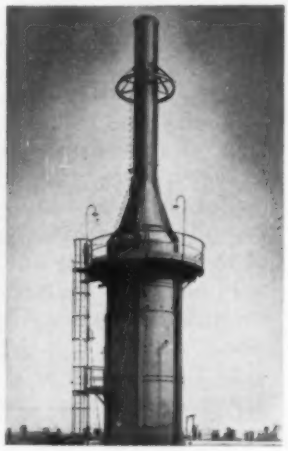
Things Companies Can Do to Build Professionalism

	Things that Engineers Say:		Things that Managers Say:	
	Are Very Important to Do	Companies Are Now Doing	Are Very Important to Do	Companies Are Now Doing
1. See that salary progression fully reflects engineers' contributions	(88%)	23%	(95%)	(73%)
2. Encourage engineers to find out how their work fits into the entire project	(77)	37	(73)	45
3. Give engineers as varied and challenging work as possible	(76)	22	(64)	35
4. Give engineers adequate supporting personnel	(74)	22	(65)	38
5. Keep engineers informed on company objectives and policies	(73)	31	(84)	35
6. Managers show that they regard engineers as professionals	(72)	18	(78)	38
7. Ask engineers' ideas on policies related to engineering	(72)	20	(62)	29
8. Allow engineers to keep own time records	(70)	(89)	(58)	(80)
9. Give engineers adequate physical aids	(70)	(59)	(69)	(69)
10. Treat engineers as individuals	(68)	28	(85)	(53)









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by Ernestine Adams

FPC Chairman Sets Ground Rules

The critical meeting between Joseph C. Swidler, new Federal Power Commission chairman, and the Independent Natural Gas Association became a search for understanding on both sides. The results brought some hope of stability if not of satisfaction to the divisions of the natural gas industry.

In his speech before the annual meeting, the chairman made these points: The Commission plans:

1. To establish area ceilings on natural gas prices as "the most important single tool" used by the FPC.

2. To set a goal of deciding pipeline rate increases within the statutory 5-month suspension period.

3. To express regulatory policies in a "clear cut and comprehensive way" to provide ground rules.

In the press conference following the speech, more specific items were covered.

Area Price to Be Ceiling

Q. You said in your speech that "area prices to be an effective form of regulation, must be set as ceilings and not as floors." What would it take to penetrate the ceiling?

A. There would be room for some minor exceptions if they penetrate the ceiling until it left it just a sieve. I didn't want to say flatly there wouldn't be any exceptions because I didn't know what special claims might be made that didn't have the effect of making the ceiling itself meaningless. It could be there wouldn't be any exceptions. The whole concept of area rate is a new one and I was only trying to give you my present feelings about it.

Q. Is any legislation needed for the Commission's plans?

A. My present belief is that the Commission has adequate authority. Throwing the problem back into the legislative hopper will simply add uncertainty and confusion that has existed now for so many years. We are proceeding now on the basis of the Natural Gas Act and I think we ought to continue to forge ahead without looking over our shoulders to Congress and say — "Come rescue us." If this thing is turned back to Congress you don't know what you're going to get or how long it will take to get it.

Q. Your program could be thrown over by the courts?

A. Yes, it might be thrown over by the courts without new legislation and it might be thrown over with legislation. You don't know what you'll get. You know what you can ask for but you don't know what's coming out.

Q. Do you have an opinion on the direction in-place purchases of gas in the field are likely to take?

A. Anybody could make in-place purchases. If that became the predominant vehicle for acquiring gas supplies and if that were excluded from the Commission's jurisdiction that automatically solves the producer's problem by in effect repealing the Phillips decision. To be meaningful regulation of natural gas must cover major transfers whether through purchases of supplies in-place or at the wellhead.

Q. Are there any plans to increase the Commission's staff?

A. Yes, there are, because we'll be asking for more money for the next fiscal year and we may ask for a '62 supplemental.

Q. Do you favor excluding small gas producers from FPC control?

A. Yes, I do, if it can be done without imparing our efforts to carry out regulatory responsibilities. There's a large view of thought that believes such exemptions can be made to the advantage of the Commission's work. The idea is under study.

Q. Have you decided the size that will form the dividing line of those who will or won't be under control?

A. The Commission's staff is looking at various requisites.

Q. Do you think the Commission has authority to do that now?

A. I think they have authority to do that now the way we are planning to do it. I don't intend to do anything our general counsel doesn't approve. I do think we have some elbow room in this field.

Q. You say the FPC has played a significant role in the development of the natural gas industry. Would you explain what role the FPC has played in development of the producing segment?

A. I don't know how to answer that question. Of course, the larger producers were well established and solvent long before the Natural Gas Act. In the long run, bringing a degree of stability to the growth of the industry and to its price structure is going to help all the industry, including independent producers.

Q. What is the difference between the cost-plus basis and area pricing?

A. The difference is a fellow who wants to drill will know what he will get for his gas if he finds it.

Q. Will cost be the basis of area pricing?

A. No, I tried to make it clear that cost will be only one of the elements and the advantage is that the man will know what he'll be able to get for the gas he discovers and the consumer knows how much he's going to have to pay for it. The different owners will get the same price instead of different owners getting various prices. This seems to me not to make sense for the gas production end of the business.

Q. Will this be similar to posted prices of crude oil?

A. Without knowing too much about the oil pricing system, I can't answer this.

Q. If you set a price for natural gas in one area would that automatically change the contracts already made in that field?

A. No, this would not set aside contracts now in effect.

Q. The gas people have set up a program to get some idea of what's ahead. What do you think of this?

A. It seems to be a very sensible thing for all of us in the industry to find out what we have on our shelves and how many purchasers we have. We are proceeding without a really valid knowledge of what gas is available and what markets exist for it.

Q. Have the producers had an opportunity to comment to you what they think about area pricing?

A. Representatives of the industry I have talked with say they think area pricing is the answer. As a protection, they say they reserve all their legal rights to challenge the result. I think they are reserving rights depending upon what price comes out in the area in which they are interested.

Q. You said "All elements must work together to instill and maintain a justified sense of complete assurance in the adequacy and continuity of natural gas supply, and at a price which will preserve its status as a fuel which is not only convenient and dependable, but inexpensive as well." I'm wondering about "inexpensive."

A. I'm trying to look at it from a consumer's point of view. We can market something that is good and costs a little more. But it's a much smaller market than it would be for something better that costs less. It is better for producers and consumers to think of gas as something that is best but also a little cheaper.

Q. Why don't you believe that normal supply and demand would take care of the situation?

A. I'll let you argue that one out with Congress.

Q. You say you wonder how a system with no unified responsibility could operate efficiently. What do you suggest that would provide that unified responsibility?

A. Maybe there's more to this system than meets the eye. I think I would want to understand better how this system works before trying to develop any ideas on changing it. I'll confess the ten weeks I've put into this industry has not been adequate to give the answer to that.

What Comes Next?

The hope for the natural gas industry is that principles and problems of all interests be stated and a meeting of minds set out. Chairman Swidler, the consensus held, was a man of reason and intelligence. The vision of stability quieted other concerns for the immediate future. Worn with the long fight, gas people were inclined to give the new FPC chairman a chance to develop methods of discharging his responsibilities before voicing criticism. ■

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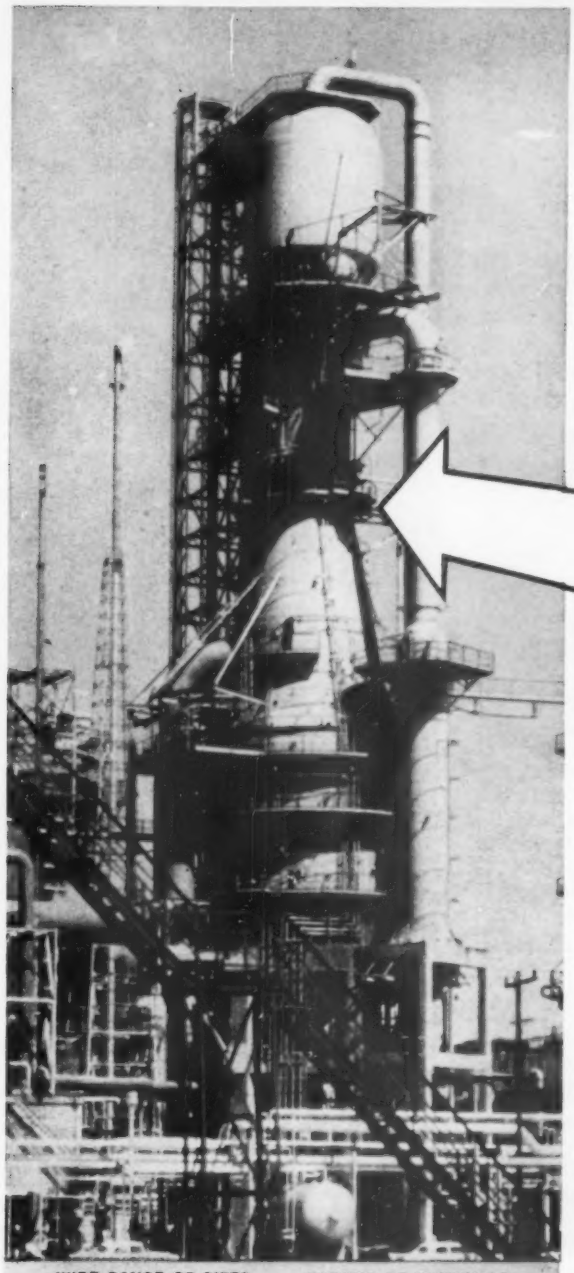

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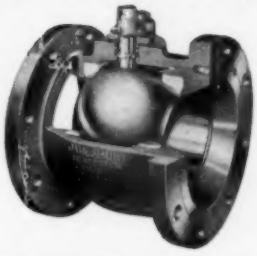

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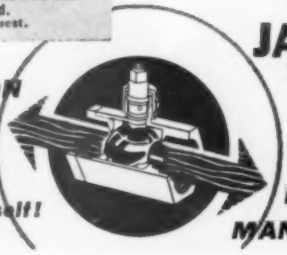

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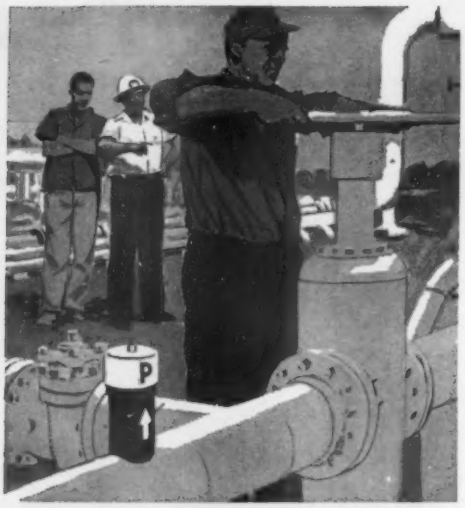
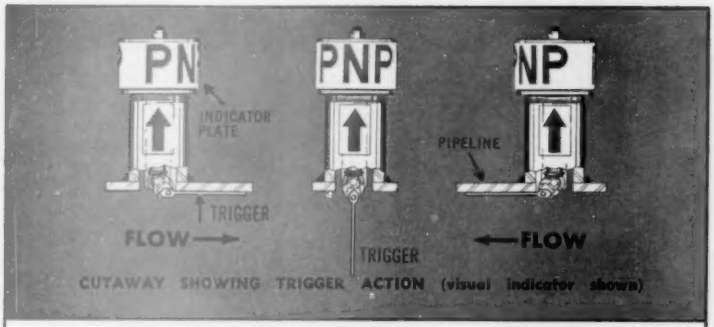
Plus Other Optional Features





• The WmSon PIG-SIG II Scraper Passage Indicator which has earned such wide acceptance in the pipeline industry is now available with bi-directional trigger as an optional feature. The trigger is designed for use in lines where scraper travel may be in either direction and in meter proving loops. Other optional features: pneumatic control with automatic reset and automatic counter to record scraper passage.

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For additional information write Dept. B. for Bulletin A-199-A

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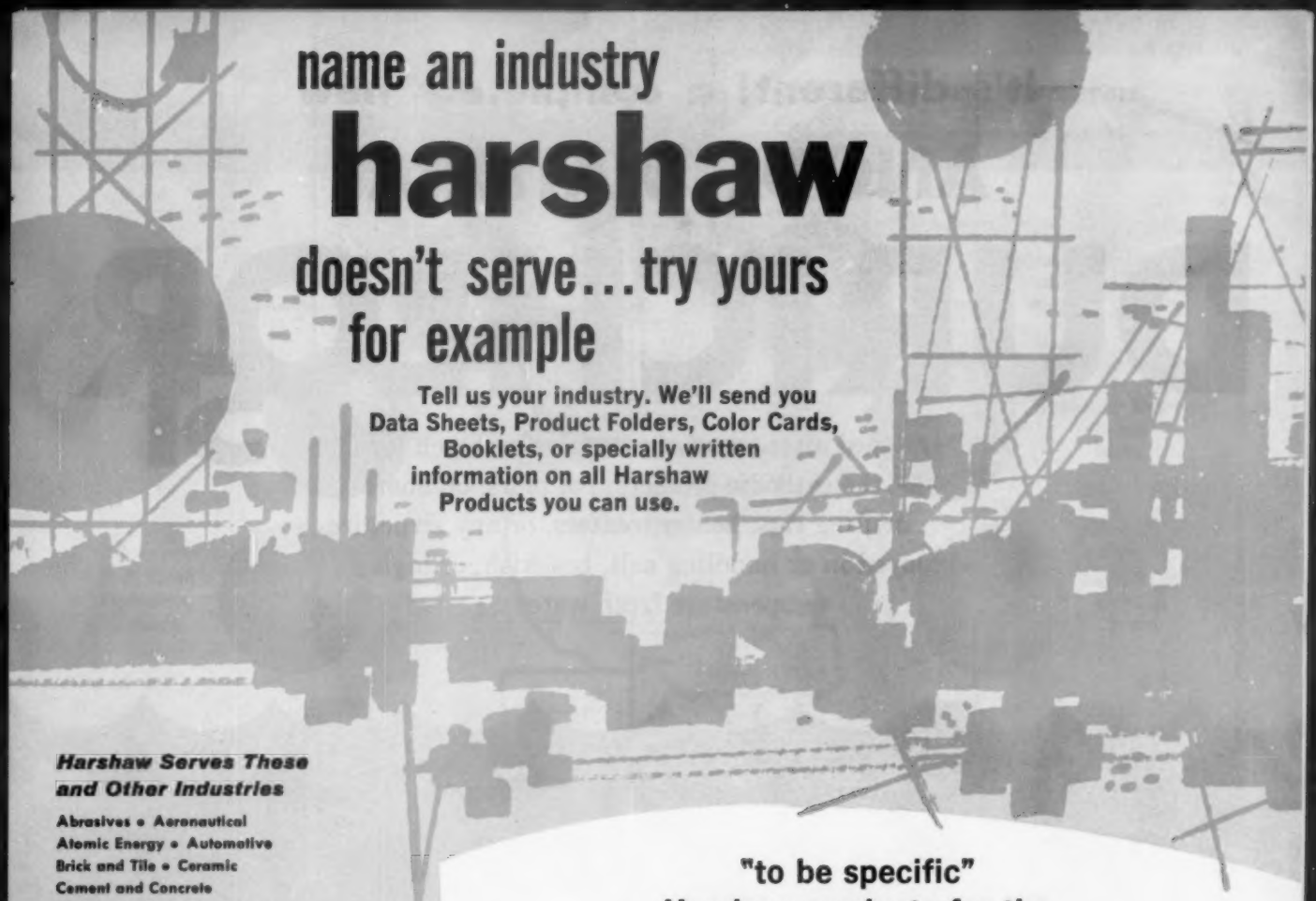
REPRESENTATIVES AROUND THE WORLD

PIG-SIG II can be used to actuate pneumatic and electric control systems. WmSon engineers may be able to offer dollar saving tips on its use in such systems. **Contact your representative or the Tulsa office.**



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DURICHLOR 51 was developed as an anode material for application of impressed current cathodic protection in aggressive salt and brackish waters, high temperature fresh waters, and in chloride containing soils where the chlorine generated at the anode surface was not free to permeate to the surrounding environment. Structures include steel support members for terminals, docks, off-shore drilling rigs and others exposed to sea water; heater-treaters, water box coolers, industrial hot water tanks, and similar fresh water applications; and pipe lines, storage tanks, well casings, and other underground structures.

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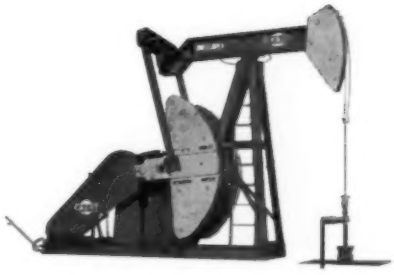

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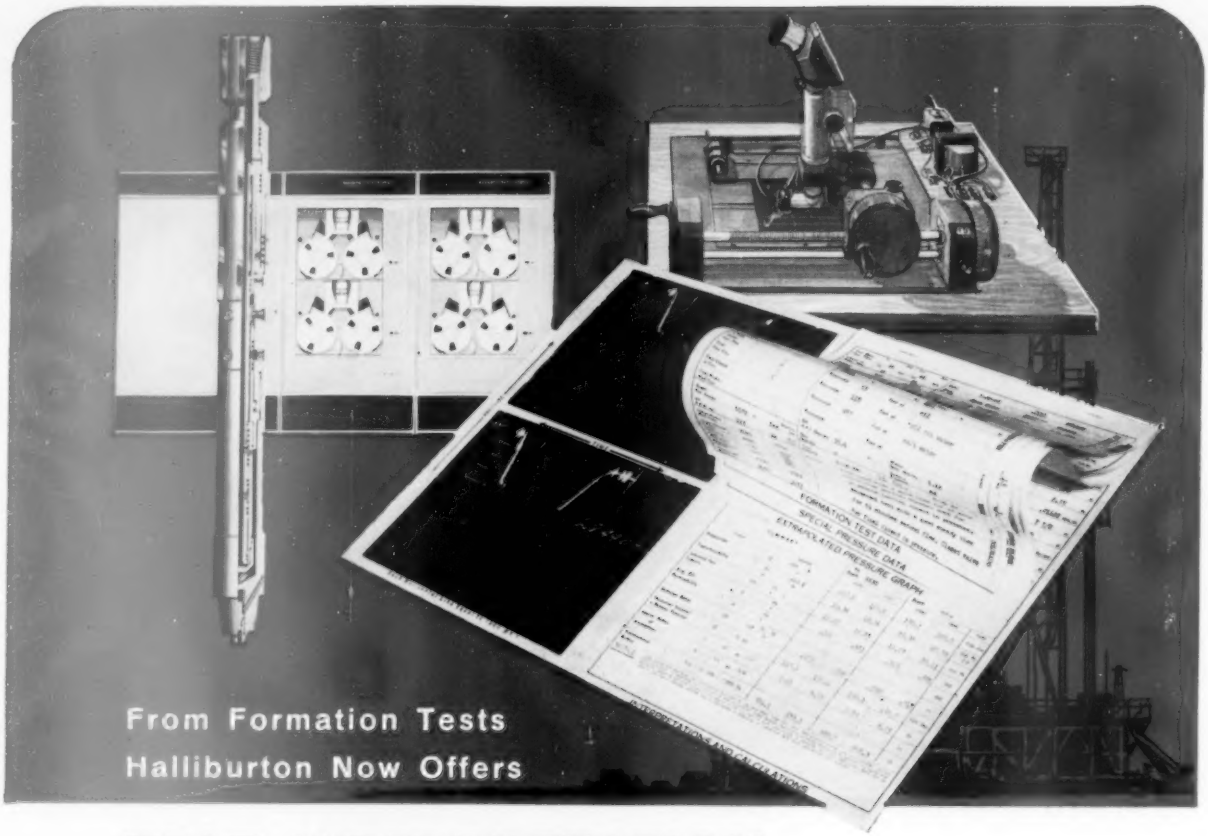

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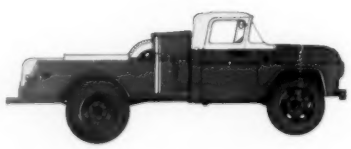

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Things To Come

NEW WELLS INCREASE

Compared to the slump of 1959 and 1960, this year and next should bring good news to drilling contractors, suppliers and manufacturers. Warren Baker, AAODC executive vice president, looks for some 49,000 total wells to be completed this year. For next year and beyond, he sees 49,000 to 51,000 new wells, a big improvement over 1960 when only 46,700 wells were drilled.

THREADLESS JOINT

Field tests in various drilling applications have been conducted on a revolutionary idea for drill pipe tool joints. Based on the same principle as Shaffer Tool Works' right-hand releasing safety joint, the new tool joint has no threads. A barrel (as the box end) and a mandrel (as the pin end) are mated by heavy lugs or keys riding in helical grooves on the mandrel. Making and breaking the joint are quick and require no spinning in or tonging. A progress report on the joint appears in this issue.

OFFSHORE DRILLING UP

Lure of open water plus development of sub-sea well completions has intensified the romance of way-offshore drilling. Success of floating rigs such as the CUSS I points the way for other vessels to follow. Bigger and better floating drilling vessels will appear off the California coast. Excellent prospects off the Louisiana coast coupled with Federal offshore lease sale next spring encourage testing of modified mobile units floating in deep Gulf waters.

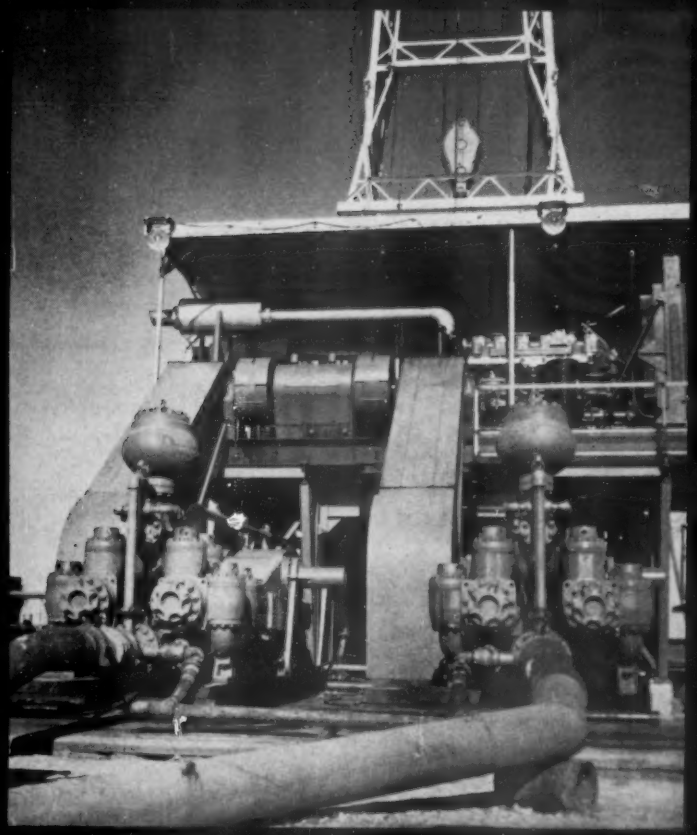
NATURAL GAS TO GROW

Bright horizon in petroleum is natural gas, according to Edward E. Monteith, Jr., vice president of Republic National Bank of Dallas, who predicts production will increase about 4% annually to 50.6 billion cu ft per day by 1970.

USSR TO BOOST GAS

The Soviet Union hopes to increase gas production to provide 17.5% of its fuel needs in 1965. In 1960, gas provided 10.3% of the total fuel needs for Russia; 32.8% of U. S. fuel needs were supplied by natural gas and natural gas liquids. The Russians estimate 1965 gas production will triple 1960 output.

Ask J&L Supply about . . .



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. . . Gardner-Denver pumps
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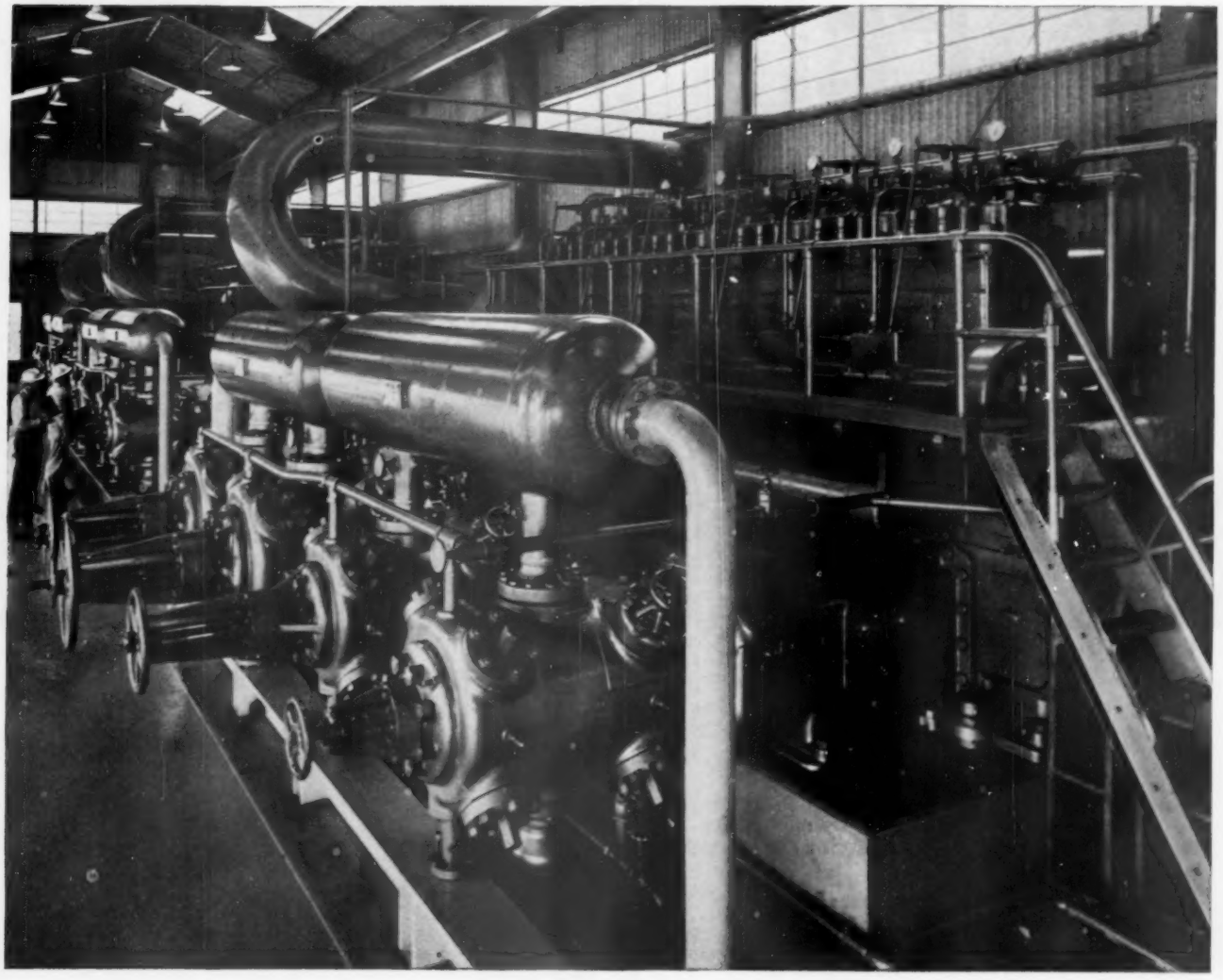
$270 per horsepower *at Shell Delta Location*



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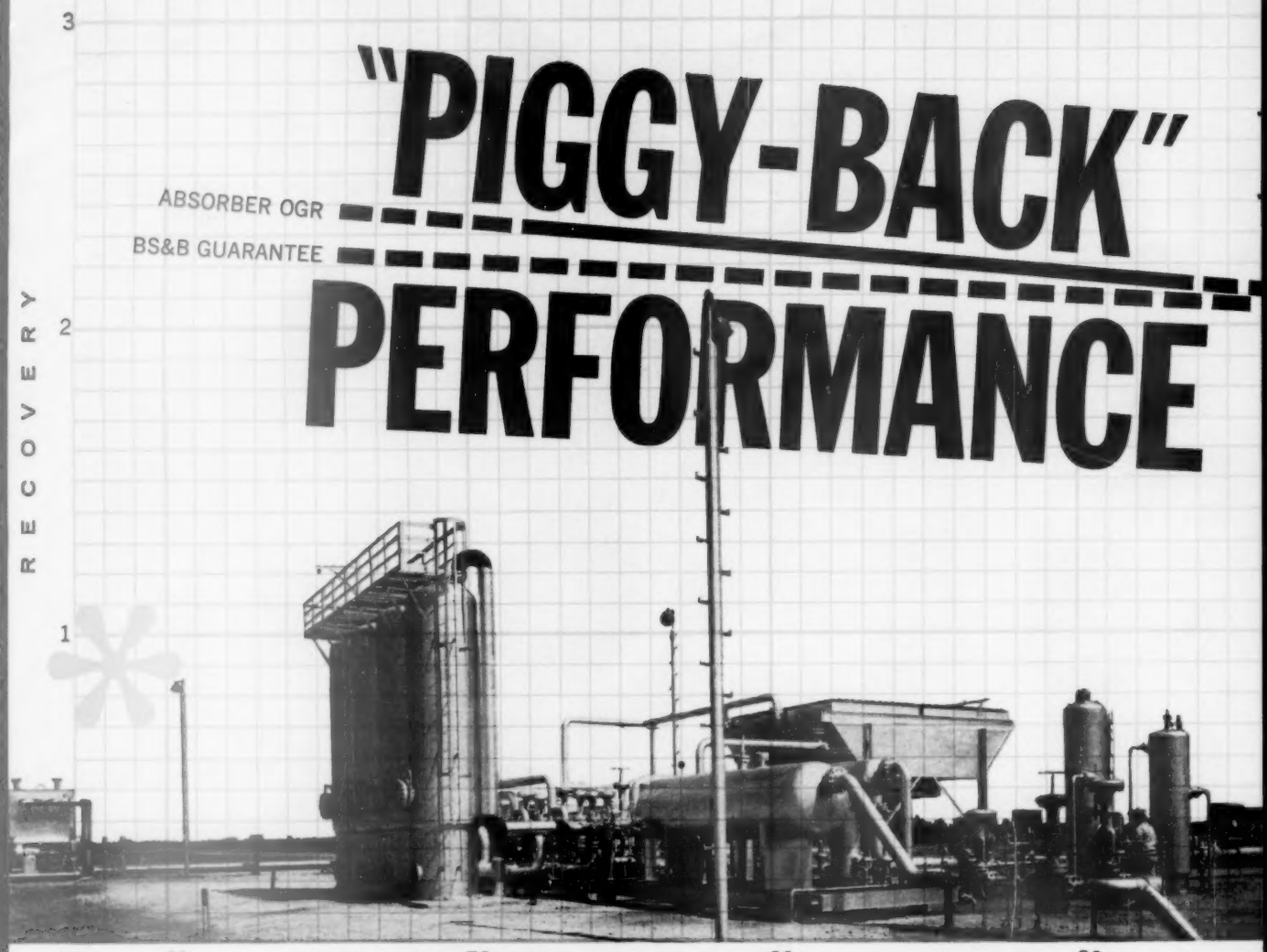
OIL · GAS · CHEMICAL
ELECTRONIC · INDUSTRIAL

Working together in allied industries . . .

ROOTS CONNERSVILLE — *Blowers, Compressors, Gas Pumps, Rootsmeters, Vacuum Blowers*

PODBIELNIAK — *Centrifugal Contactors, Distillation Apparatus, Instrumentation*

"PIGGY-BACK" PERFORMANCE



Look at the liquid recovery curves for this BS&B DRY FRAC Unit. Actual recovery rate slightly exceeds and parallels the guarantee so closely we will call it "piggy-back" performance. This takes real process know-how.

Lean streams, rich streams, sour or sweet... BS&B has the equipment to handle them all. Glycol or dry desiccant dehydration. Desulfurization or CO_2 removal. Low temperature separation with natural, mechanical, or ammonia absorption refrigeration. Or cold feed stabilization.

The economics of YOUR situation will dictate selection of the proper equipment for the highest rate of return and quickest pay-out.

Want to discuss your gas processing requirements in preparation for the big gas demand ahead? Call your nearest BS&B sales office, or write to Black, Sivalls & Bryson, Inc., Box 1714, Oklahoma City, Okla.

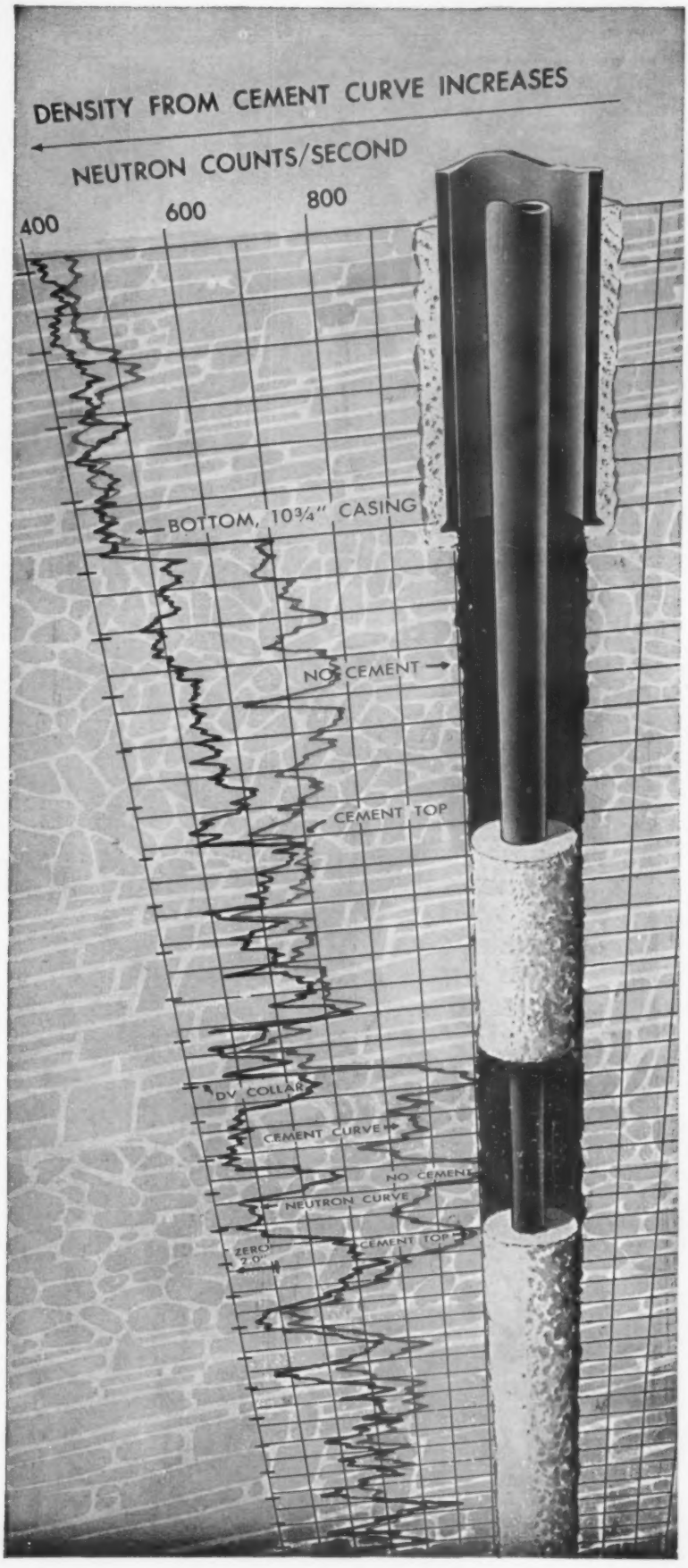
The new BS&B "Uniflux" Heat Exchanger is an important component of this DRY FRAC Quick Cycle Hydrocarbon recovery unit. Instrumentated with completely automatic controls to assure safe, efficient operation, "Uniflux" heats with high temperature inert gas with no flame impingement on tubes. Fast response to heat and cooling loads make it ideal for intermittent service.

Manufacturers of: Oil and Gas Field Processing Equipment, Control Valves, Safety Heads, Electronic Instrumentation, Heat Engineering Equipment, Mass Flowmeters, Filament Wound Glass Fiber Products, and Grain Storage and Processing Equipment.

BS&B

BLACK, SIVALLS & BRYSON

OKLAHOMA CITY • KANSAS CITY • TULSA • EDMONTON • THE HAGUE



McCullough

NUCLEAR CEMENT LOG

with Scintillometer ®

—lets you SEE

your cement column

Here's an improved cement locating log that accurately "pictures" the cement column in your well. It will identify the presence of the cement column, confirm the quality of the job, locate cement tops, indicate uncemented sections and possibly detect channeling. It is equally effective in new wells or in old wells of any age.

The McCullough Cement Log records a curve which reflects the density of the material behind the casing. Thus, the location and characteristics of the cement column, when it differs in density from the displaced fluid, can accurately be determined.

This log is usually run on the same trip into the well with other nuclear well surveys, thus requiring no extra rig-time. In fact, the cement curve can be one of six separate logs, all revealing different down-hole information, that may be obtained on a single run without coming out of the hole. Also, it is very economical, price-wise, when run in combination with other nuclear logs.

Proved thoroughly effective on hundreds of jobs, the McCullough Cement Log is being adopted as standard procedure for determining the effectiveness of the primary cement job, checking squeeze jobs and for use in future workover or remedial operations.

The Cement Log shown at the left is made up of sections of an actual log run in 5½" OD casing from 3800' to surface. All information shown is exactly as it appeared on the original log.

McCullough

TOOL COMPANY

Los Angeles • Houston • Edmonton

Cable Address: MACTOOL

Trinity
LITE-WATE
A Complete
LOW-DENSITY CEMENT

No loss to weak formations

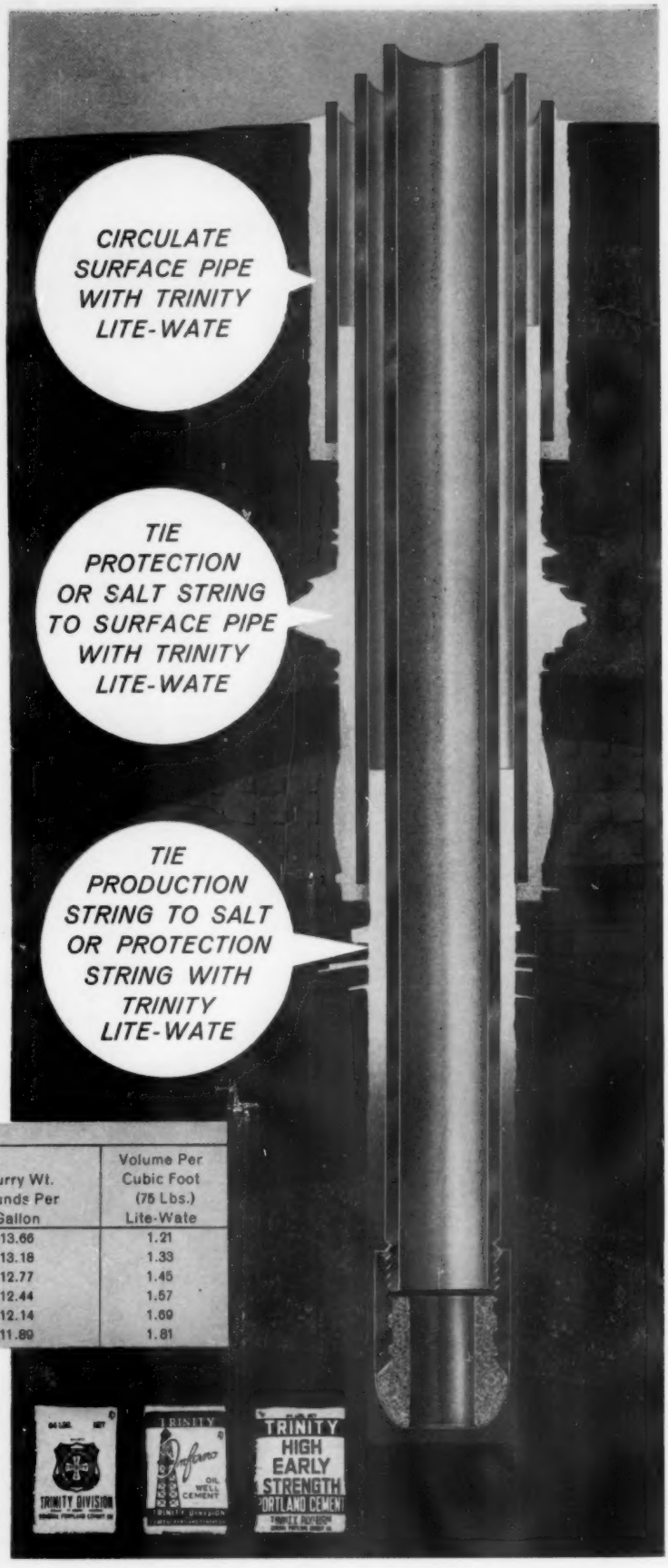
Trinity Lite-Wate is a neat oil well cement with a low slurry density. Nothing to add but water. It derives its light weight properties entirely from the high quality raw materials from which it is made. Easy mixing, easy pumping, can be circulated with low pump pressure and without loss to weak formations. It has proved satisfactory in circulating the surface pipe, tying protection or salt string to surface pipe and tying production string to protection or salt string.

Trinity Lite Wate has been in use for several months in such varying well conditions as found in West Texas, Oklahoma, East Texas, Louisiana, Gulf Offshore and New Mexico, it has produced returns in *every case* where attempted.

SLURRY PROPERTIES

All slurries were mixed in accordance with procedures in the API RP 10B. Slurry weight and volume were calculated on the basis of Lite-Wate specific gravity of 2.80. Absolute volume 3.22 gallon. Absolute volume cubic foot 0.43.

Mixing Water				
Per cent	Gallons Per Cubic Foot Lite-Wate (Dry Vol. 75 Lbs.)	Initial Viscosity Poises	Slurry Wt. Pounds Per Gallon	Volume Per Cubic Foot (75 Lbs.) Lite-Wate
65	5.85	13	13.66	1.21
75	6.75	5	13.18	1.33
85	7.65	4	12.77	1.45
95	8.55	3	12.44	1.57
105	9.45	2	12.14	1.69
115	10.35	1	11.89	1.81


CIRCULATE SURFACE PIPE WITH TRINITY LITE-WATE
TIE PROTECTION OR SALT STRING TO SURFACE PIPE WITH TRINITY LITE-WATE
TIE PRODUCTION STRING TO SALT OR PROTECTION STRING WITH TRINITY LITE-WATE
TRINITY DIVISION
TRINITY
Inferno
OIL WELL CEMENT
TRINITY
HIGH EARLY STRENGTH
PORTLAND CEMENT

TRINITY

PORTLAND CEMENT DIVISION

GENERAL PORTLAND CEMENT COMPANY

DALLAS · FT. WORTH · HOUSTON

NEW FROM CAMCO...

the Industry's most complete line of

Pilot-Operated Valves

Conventional and Retrievable . . .
Large-ported for deep intermittent lifting

Camco now introduces the most complete selection of pilot-operated gas lift valves available to the industry. Both conventional and retrievable types are manufactured, for installation in **standard Camco Mandrels:** The **CP-1** and **BP-1** valves for Camco C and B Conventional Mandrels respectively, the **RP-1** and **PK-1** for Camco MM and K Sidepocket Mandrels respectively, and the **RPB** retrievable pilot-operated bleed valve for chamber installations.

These large-ported valves are ideal for dual gas lift and for deep intermittent lift where injection gas pressure is low relative to depth.

Control of spread—Valve spread can be changed by varying port size in pilot section.

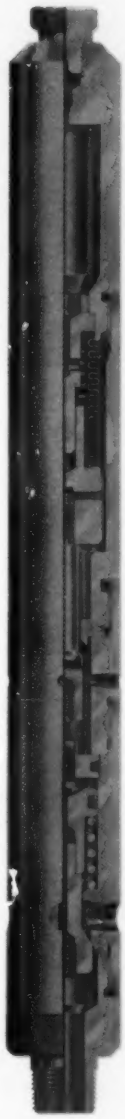
Large gas passage—Main inlet valve is large-ported regardless of pilot valve spread, allowing maximum injection gas to enter tubing.

Snap-acting main inlet valve opens and closes without throttling.

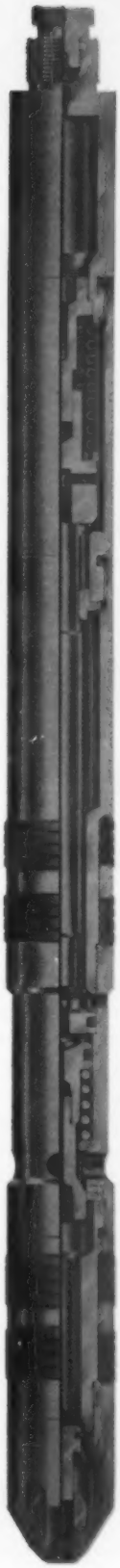
Simplicity—Main valve is a simple, sturdy spool valve.

Proven design—Pilot sections have design and construction features of Camco gas lift valves proven by many years of field use.

New Camco Pilot-Operated Valves are backed by the industry's greatest experience in designing and building gas lift valves. For more information, call your Camco representative or write



CP-1 VALVE



RP-1 VALVE

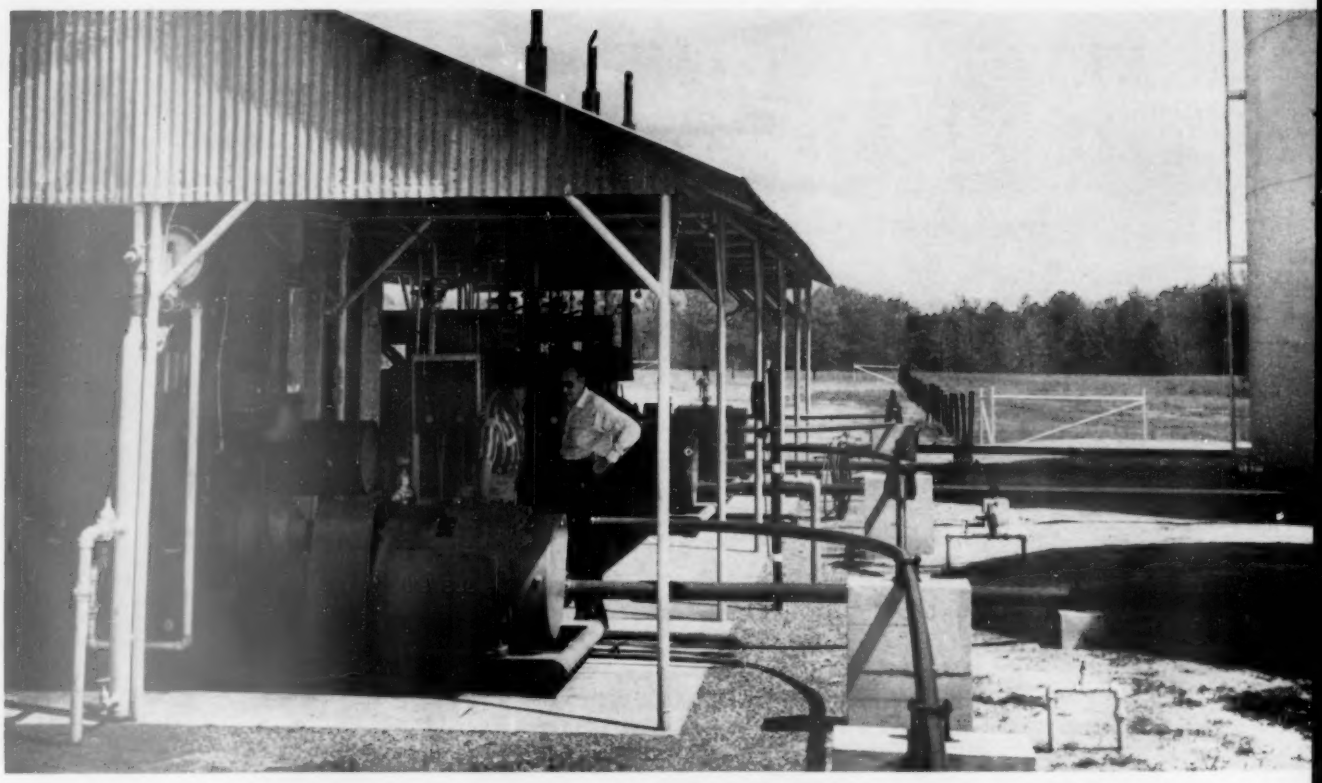
CAMCO

"PRODUCING PETROLEUM PROGRESS"

CAMCO, INCORPORATED

Box 14484, Houston 21, Texas

CAMCO, LIMITED, Belfast, U.K. - CAMCO DE MEXICO, S.A., Mexico, D.F



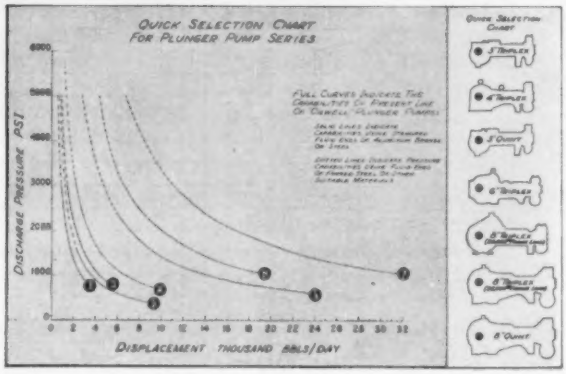
Why "Oilwell" waterflood pumps take it lying down

The pumps in the picture are operating in the New Odom field, and one of them has been pumping 24 hours a day for *eight months* without stopping. Naturally, it's an "Oilwell" pump and its design has a lot to do with its performance.

Every "Oilwell" plunger pump is designed horizontally for eight good reasons: *Low suction* . . . lowness of suction and discharge lines means maximum utilization of suction head and simplifies piping layout. *Less deadweight on crankshaft* . . . eases bearing loads, minimizes vibrational stress in frame and piping. *Simpler thrust transmission* . . . eliminates overhead yoke and pull-rod assemblies. *Cleaner installations* . . . any leakage is confined to frame cradle by gravity. *Natural valve motion* . . . fewer parts needed. *Low center of gravity* . . . reduces vibration that can cause piping stress and fatigue. *Safer maintenance* . . . does away with ladders and neck-craning. *Easier maintenance* . . . greater accessibility.

There's a wide selection of top-performing "Oilwell" Triplex and Quintuplex pumps for waterflood applications, LPG Flood, Pressure Maintenance, Formation Fracturing, Acidizing and Cementing, Salt Water Disposal, or you name it. Whatever your requirements, call on "Oilwell" for complete information and help in the planning stage.

USS and "Oilwell" are registered trademarks

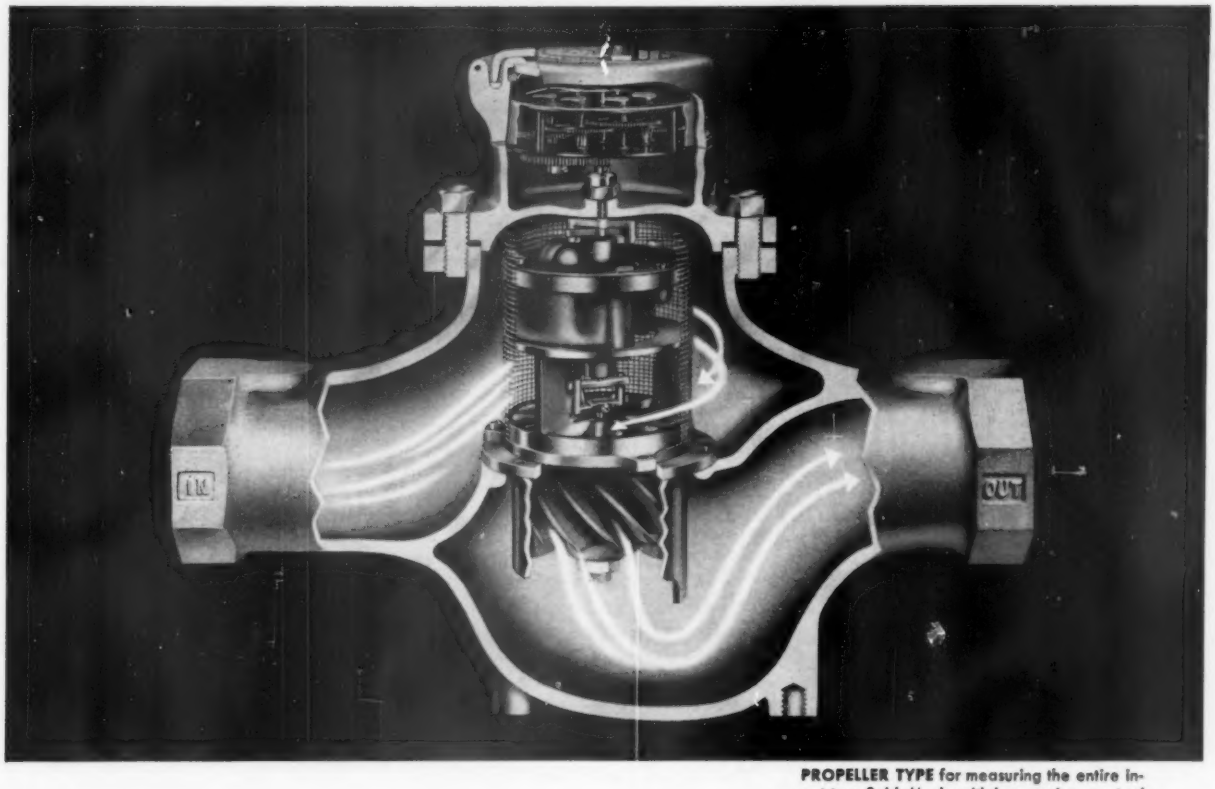


The plunger pump selection manual describes in detail "Oilwell's" complete line of seven primary pumps. Volume-pressure range curves make it a simple matter to pick the pump that's right for the job. Picking plunger sizes is simple, too, because you'll find complete performance data for all plunger sizes available with each size pump.

Write on your company letterhead for a free copy of "Oilwell's" Manual M29-1060. It's one of our ways of making sure that when you buy "Oilwell" equipment, you get a lot more than our product.

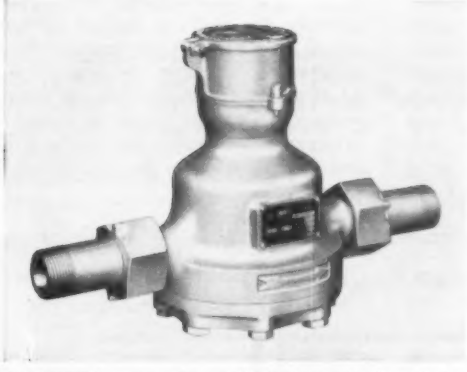
USS Oil Well Supply Division of United States Steel

Executive and Export Offices: Dallas, Texas



PROPELLER TYPE for measuring the entire input to a field. Made with bronze, iron or steel cases for up to 2500 psi working pressure in sizes 2" to 6".

Why 3 out of 4 secondary recovery systems use ROCKWELL METERS



DISC TYPE for measuring and balancing water input to individual wells. Sturdy bronze case is designed for 2000 psi working pressure. Optional coupling sizes of ½", ¾" or 1" simplify installation.

Over twenty years ago we developed the first successful meter to measure water forced into the ground at spaced flooding points. Now about 75% of all secondary recovery systems use Rockwell meters.

Successive improvements, plus optional materials make today's meters an even better buy. For instance interior parts of either bronze or nickel alloy are optional depending on an analysis of the water.

In both the propeller and disc types, the meter register has a sweep hand with a dial reading to 1/10th barrel per revolution. This permits you to time input rates quickly and accurately.

You can buy Rockwell meters right off the shelf at leading supply stores. Ask for them by name.

Write for free wallet size "Reddi-Rate" setting table to simplify your calculations. Rockwell Manufacturing Company, Dept. 123K, Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Co. of Canada, Ltd., Box 420, Guelph, Ont.

Buy at Your Supply Store

WATER FLOODING METERS
another fine product by
ROCKWELL

Better Production Tools Through Research

OTIS Equipment NEWS

Volume III, Number 4 **Otis Engineering Corporation • Dallas** *Production Equipment and Services*

New Low Pressure Pilot System Offers Simplified Multi-Point Protection In Surface Safety Valve Installations

DALLAS—Two new Otis Pilots have been developed that make possible a well safety system that includes: (1) Multi-point protection utilizing a low pressure control line and (2) Single point, single step resetting to place the entire system back in service after a shut-in. The two new pilots are the Type N Otis Actuator Pilot and the Type P Otis Hi-Lo Auto-Reset Pilot. Both can be used with any one of several different Otis Surface Safety Valves.

A Type N and P Otis Pilot System, when combined with the proper Otis Surface Safety Valves, may be installed to protect a single well or a number of wells such as may be located on an offshore platform. The simplest installation is where a low pressure line connects the Type P Pilots at the point where protection is desired and the Type N Pilot on the safety valve. With this type of hook-up pressure changes from the flow line, sales line, heaters, separators, etc. are automatically transmitted from the Type P pilot to the Type N Pilot and Safety Valve.

Evidence of the acceptability of the new Type N and P Otis Low Pressure Pilot System within the various levels of field operating personnel, from superintendents and engineers through pumpers and gaugers, is indicated by the large number of installations made during the short time the equipment has been available.

Application

The application of the Type N and P Otis Pilot System is practically unlimited — from a single well, simple line pressure installation to a complex, multiple well installation that requires a number of protection points for various conditions that could cause serious loss.

Basically the Type N and P Otis Low Pressure Pilot System is designed to monitor pressure increases or decreases at such points in a surface safety installation as line pressure, separator, LTX unit, free water knockout, heat exchanger and other field processing or production equipment. The system may be installed to monitor various other conditions, also, such as liquid levels, high or low temperatures, volume, viscosity, etc. Electrical control of the system — radio, direct wire or microwave — can be added through the use of solenoids and other electrical equipment. A typical installation, in schematic form, is below.

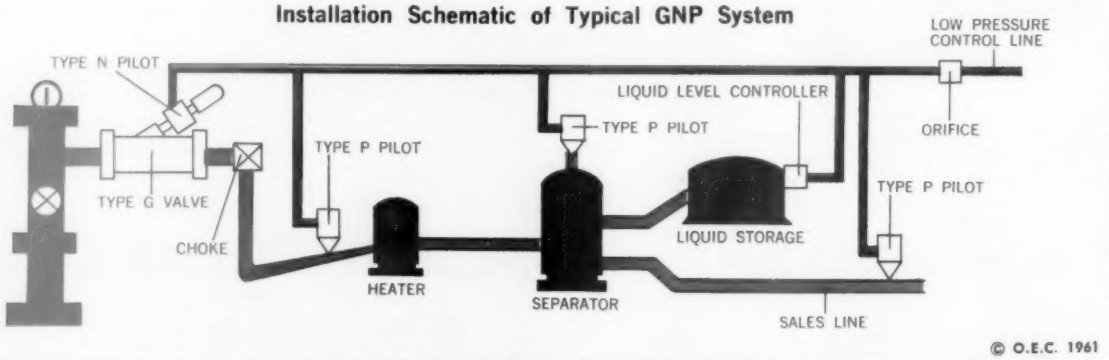
Here are several of the System's Feature Design Principles —

Low Pressure Control Line

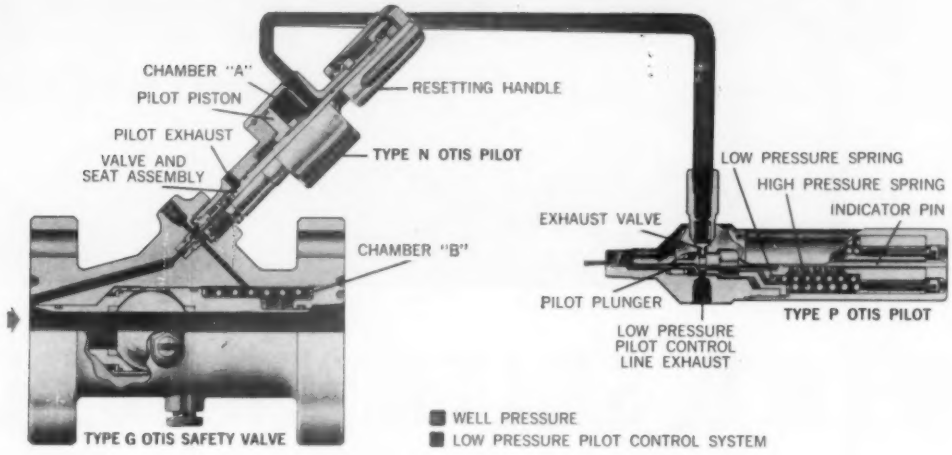
The Type N and P Otis Safety System is designed around the use of a low pressure (usually 30-60 p.s.i.) control line that connects the Type P Monitor Pilots with the Type N Actuator Pilot attached to the safety valve. The use of the low pressure line all but eliminates the possibility of hydrates forming and freezing the line — increasing the reliability of the safety installation. When a shut-in occurs, only one high pressure exhaust takes place . . at the safety valve. Choice of source pressure for the control line is optional — pressure is usually taken from the separator or furnished by bottled gas.

The system, in simplified form, monitors pressure changes through the Type P Otis Hi-Lo Auto-Reset Pilot. Pressure fluctuations beyond the preset limitation of the Type P Pilot cause the pressure on the control line to exhaust. Upon exhaust of the control line pressure, the pressure behind the piston of the Type N Otis Actuator Pilot is removed, allowing the pilot to exhaust a pressure chamber in the safety valve. This action serves to create a pressure differential in the safety valve and permits the line pressure to close the valve.

Installation Schematic of Typical GNP System



Operating Design Principle of Type GNP System



Illustrated as an example of a Type N and P Safety System is the Otis Type G Valve combined with the Type N and P Pilots. This combination of Otis equipment constitutes a safety system suitable for sensing pressure changes from a wide range of remote points. Although the Type G Otis Surface Safety Valve is used for illustration, the pilots may be used with other Otis Surface Safety Valves.

The Type P Pilot serves to monitor pressure fluctuations (within predetermined limits) in the flow line and/or other lines. Pressure variations, either too high or too low, cause the exhaust valve in the Type P Pilot to unseat and release the constant pressure on the connecting low pressure control line. When pressure is released from the control line, the low pressure on top of the piston in the Type N Pilot (Chamber A) is released and the piston moves back, allowing a ball to seat in the bypass of the Type G Valve. With the bypass sealed, pressure from Chamber B in the safety valve is exhausted through the pilot, creating a pressure differential across the ball and flow line pressure may then rotate the ball to the closed position. The entire system may be reopened merely by turning the resetting handle on the Type N Otis Pilot since the Type P Otis Pilot is designed to reopen automatically when pressures return to normal.

Single Point, One Step Reopening

The entire Type N and P Otis Pilot System is designed to be placed back in service after a shut-in by resetting the Type N Otis Pilot on the safety valve. The operation of the system is controlled from this one point . . there are no complicated procedures or detailed resetting instructions to follow. Merely turn the resetting handle on the pilot in as far as it will go and then back it out. The Type N Pilot also may be used to lock a safety valve installation out-of-service with the safety valve in the open position.

Design Principles of The Type N and P Otis Pilots

The adaptability of the Type N and P Low Pressure Pilot System comes from the flexible design principles incorporated into the two pilots . . Type N Otis Actuator Pilot and Type P Otis Hi-Lo Auto-Reset Pilot. As the name implies, the Type N is an actuator pilot for use on Otis Surface Safety Valves. The pilot does not monitor pressure changes, but acts only as a means for closing and opening the safety valve.

Well pressure is exposed to only a small portion of the pilot's valve plunger area. The internal springs, piston and other working parts of the pilot are normally never exposed to well fluids.

The standard Type N Pilot requires manual resetting. It may be modified for automatic resetting. The Type N Pilot is regularly supplied in a 150:1 operating ratio and installation records show a minimum of maintenance.

Type P Otis Hi-Lo Auto-Reset Pilot is a combination high and low pressure sensing device (0 to 10,000 p.s.i. range). It may be installed at any point in a surface safety valve system where protection is desired. The Type P Pilot does not require manual resetting after a shut-in but is designed to reset itself when the pressure it is monitoring moves back into the range of its settings.

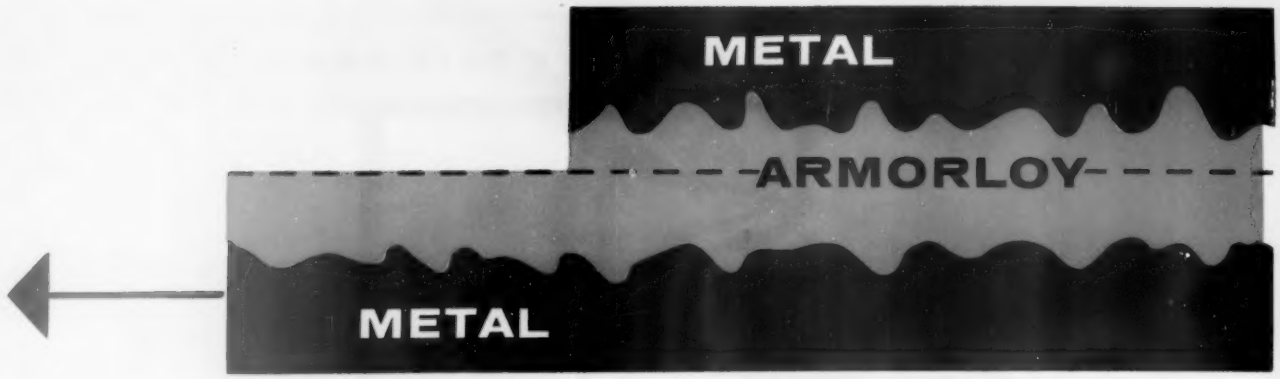
A small pin at the rear of the pilot indicates whether the pilot is set and "in-service" or whether it has operated. Pressure from the monitored source enters in only a small portion of the ½" threaded male connection. Fluids that could corrode or damage the internal working assembly do not enter the main body area of the pilot.

For more details on the construction and operation of the pilot, see illustrations above.

Safety Equipment Recommendations

The Type N and P Otis Pilots are excellent examples of Otis' leadership in safety equipment. Experienced and trained Otis Safety Equipment Specialists have the combined knowledge of the company's more than 20 years experience to draw on when making installation recommendations. Whatever your safety equipment requirements, call the Otis office nearest you or write Otis, Dept. E-4, P. O. Box 35206, Dallas 35, Texas. You'll find Otis Safety Valve Specialists ready to help you . . anxious to serve you . . with the widest variety of production equipment and services available today.

OTIS
Engineering (OTIS) Corporation
General Offices:
8812 Denton Drive • Dallas



NEW A. O. SMITH ARMORLOY CAPACITY TO PETROLEUM METERS

New solid film lubricant features exceptional corrosion resistance qualities

ARMORLOY — a new, unique lubricating film application is now standard on A. O. Smith petroleum meters. Armorloy is the same type of solid film lubricant which has been used with great success on jet and rocket engine applications.

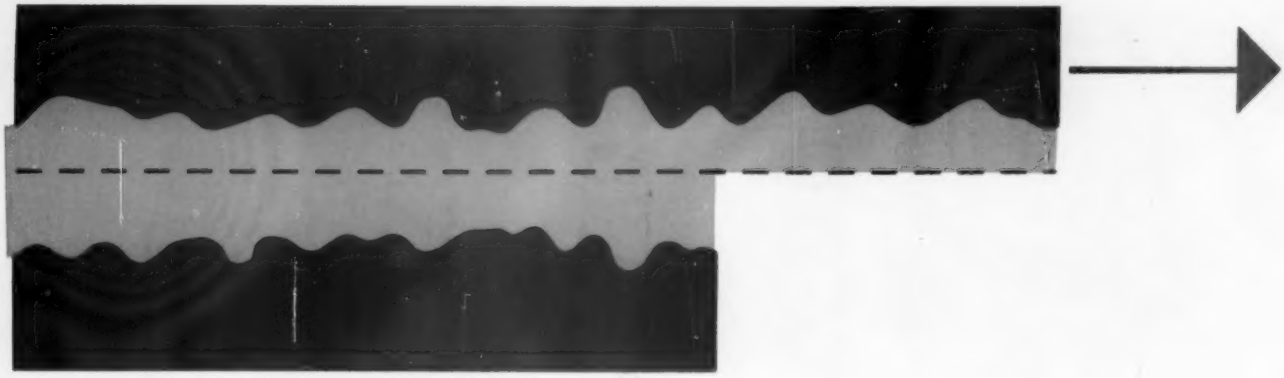
Tough as nails, the new A. O. Smith Armorloy process is especially valuable in fighting the normal corrosive action of some metered fluids. Armorloy also provides maximum protection against wear and friction for contact components because it greatly increases the self-lubricating ability of the meter.

You can't take it off without removing the basic metal — Armorloy is sprayed onto the metal surface of all internal metal components, then baked at 300 F for one-half hour. After this scientifically controlled thermosetting, Armorloy is on to stay.

Thanks to the introduction of Armorloy — plus important additional changes — A. O. Smith is also proud to announce the *new capacity ratings* for its complete line of line and high pressure meters.

Armorloy is just another step in A. O. Smith's far-reaching design program to make petroleum meters serve your industry better!

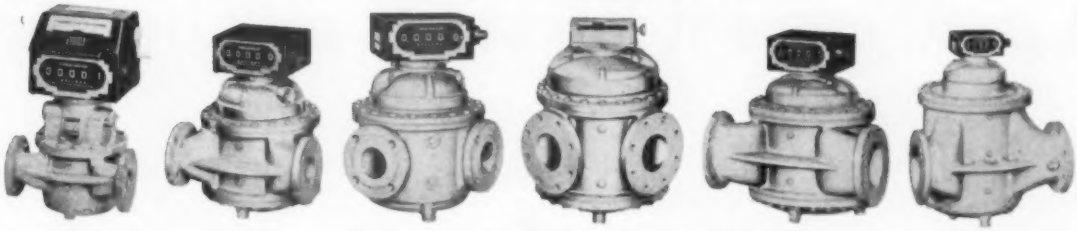
SEND FOR ARMORLOY SAMPLES! Rub them together, feel — and test — Armorloy's outstanding lubricated surface. Simply fill out the coupon and mail.



PROCESS ADDS LIFE AND EXTRA AT NO EXTRA COST TO YOU!

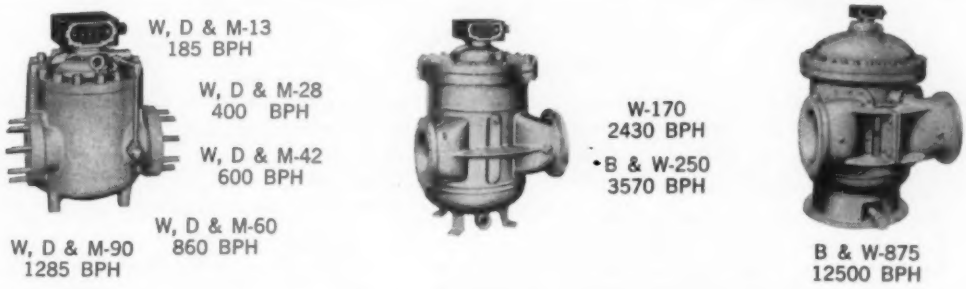
New Armorloy process helps increase meter capacity as much as 25%

LINE METERS



S & B-13 130 GPM | S-28 280 GPM | S, AS & AB-42 420 GPM | S, AS & AB-60 600 GPM | S & AB-100 1000 GPM | B-170 1700 GPM

HIGH PRESSURE METERS



W, D & M-13 185 BPH
W, D & M-28 400 BPH
W, D & M-42 600 BPH
W, D & M-60 860 BPH
W, D & M-90 1285 BPH
W-170 2430 BPH
B & W-250 3570 BPH
B & W-875 12500 BPH

Through research ... a better way

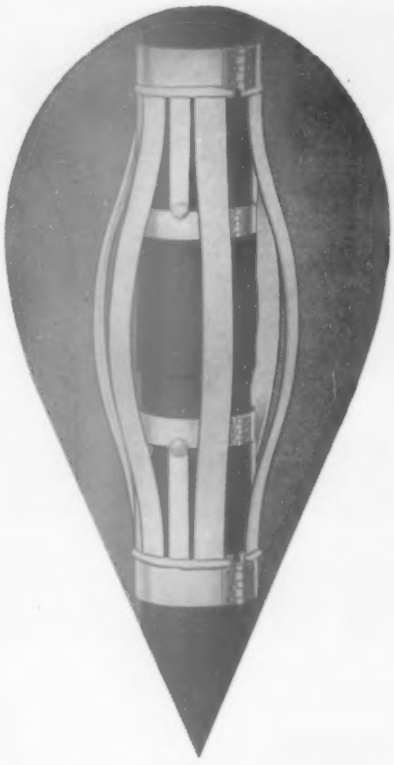
A.O.Smith
CORPORATION
METER & SERVICE STATION EQUIPMENT DIVISION

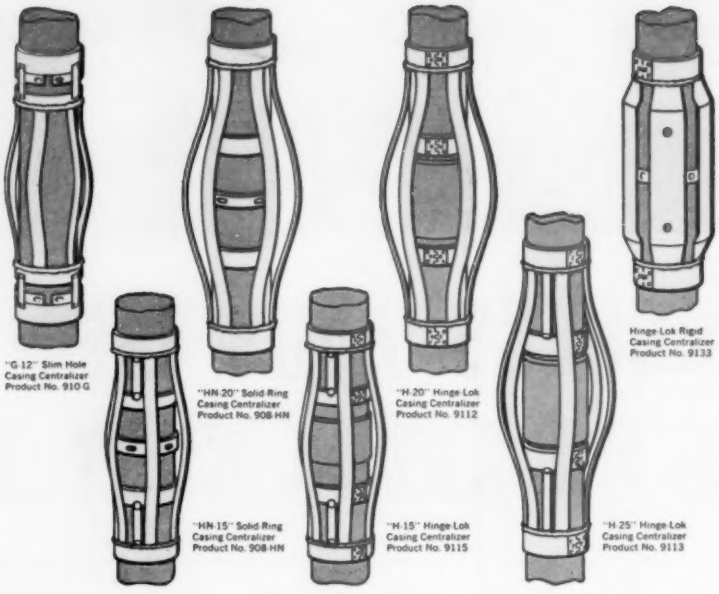
Factory: 1602 Wagner Ave., Erie, Pennsylvania. Offices: Atlanta 24, Ga.; Chicago 3, Ill.; Houston 2, Tex.; Los Angeles 22, Calif.; New York 17, N.Y.; Newark, Calif.; Tulsa, Okla. — A. O. Smith INTERNATIONAL, S. A., Milwaukee 1, Wis., U.S.A.

A. O. SMITH CORP. Dept. 0113-PE
Milwaukee 1, Wisconsin

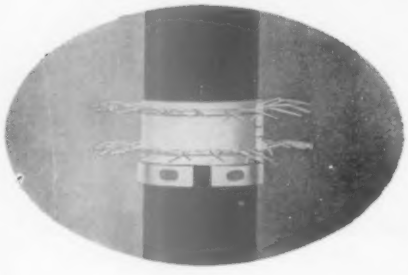
Gentlemen: I would like to see for myself just how good Armorloy is. Please send me your samples.

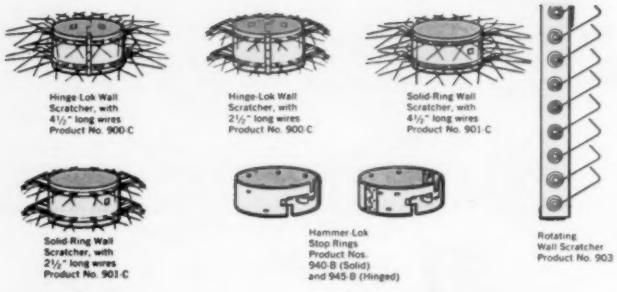
Name ..... Title .....
Company .....
City ..... Zone ..... State .....




"G-12" Slim Hole Casing Centralizer Product No. 910-G
"HN-20" Solid-Ring Casing Centralizer Product No. 908-HN
"H-20" Hinge-Lok Casing Centralizer Product No. 9112
Hinge-Lok Rigid Casing Centralizer Product No. 9133
"HN-15" Solid-Ring Casing Centralizer Product No. 908-HN
"H-15" Hinge-Lok Casing Centralizer Product No. 9115
"H-25" Hinge-Lok Casing Centralizer Product No. 9113

A good cement job starts with two things




Hinge-Lok Wall Scratcher, with 4½" long wires Product No. 900-C
Hinge-Lok Wall Scratcher, with 2½" long wires Product No. 900-C
Solid-Ring Wall Scratcher, with 4½" long wires Product No. 901-C
Solid-Ring Wall Scratcher, with 2½" long wires Product No. 901-C
Hammer-Lok Stop Rings Product Nos. 940-B (Solid) and 945-B (Hinged)
Rotating Wall Scratcher Product No. 903

A good primary cementing job starts with centered casing and a good bonding surface. The only centralizers and scratchers good enough for this important job are the best ones you can get. That's where Baker comes in...

BAKER CENTRALIZERS are tough and resilient to withstand running-in forces. They are made in a wide range of spring-bow heights to provide one exactly right for your specific casing program. That's why when you're landed your casing has adequate clearance for good cementing. For installation convenience, Baker Centralizers come in both Hinge-Lok and Solid-Ring types.

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by J. E. Kastrop

What's Ahead in Contract Drilling

In the wake of the roughest period most U. S. drilling contractors have ever experienced, what's the outlook for the industry?

For the past three years, because of imports and stabilizing of domestic demand, the supply of drilling rigs has far exceeded the requirement to drill fewer wells.

By the end of 1958, a number of smaller contractors had sold out or stacked their rigs. In 1959, and particularly in 1960, the industry lost more contractors through bankruptcy, outright purchases, repossessions and mergers.

For those who have managed to survive . . . and there are several who have done very well, profit-wise . . . the economic squeeze has been felt throughout their organizations. Cutthroat bidding continues as a result of excess rigs in some areas. However, in other areas such as offshore Louisiana, the rig supply is closer in balance with rig demand.

What changes have been made during these adjustment years? What have some of the contractors done to survive, and how are they getting along today? What about next year and beyond? Further, what's the drilling picture to 1970?

To get the story, PETROLEUM ENGINEER conducted extensive interviews with a key group of drilling contractors and other industry leaders. Questions we asked and the answers, reflecting the industry situation as these men see it, are on the following pages.

QAQAQAQAQAQAQAQA

WARREN L. BAKER
"... well completions this year might approximate 49,000."

H. F. BEARDMORE
"Just cutting price is not necessarily the way to get a job."

ALVIN C. HOPE
"Drilling has hit bottom ... modest increases are to be expected."

"... well completions this year might approximate 49,000."

Warren L. Baker, executive vice president, American Association of Oilwell Drilling Contractors, Dallas, Tex.

Q. What is your thinking regarding the general economic outlook of the domestic petroleum industry?

A. The domestic industry still has a lot of problems and economic improvement is going to be rather slow. I do not foresee any big increase in producing rates or probability of improvement in crude oil prices. There doesn't seem to be much chance that Texas, for example, can look forward to an increase in producing days in the near future. The immediate outlook in other oil-producing states does not include any sharp increase in producing allowables.

Q. What about the import situation?

A. It is difficult to foresee what the government might do, but I do not anticipate any substantial change in imports. They might be reduced somewhat, but the amount would be relatively small.

Q. What, in your opinion, are the most significant ills of the industry and briefly what can be done about them?

A. The most significant ill is an oversupply of oil, not only domestically but world-wide. We have much greater producing capacity than is currently needed. Unfortunately, U. S. demand rates have not increased in keeping with production gains of previous years, but I suppose this is going to continue with us for a while. We are going to have a smaller annual gain. Whether demand abroad will continue to increase as in the past will depend on whether these areas continue to enjoy a relatively good economy and industrial expansion continues.

Q. What is your prediction on the number of wells to be drilled this year?

A. With the increase in rig count recently, we will experience an increase in wells drilled over 1960. In the first seven months of 1961 we've completed 1200 more wells than in a comparable period last year, and there is a possibility the number of wells completed this year might approximate 49,000.

Q. Do you have any thoughts beyond this year?

A. My thinking is that we are going to stay around 48,000 to 50,000 or perhaps a maximum of 51,000 wells annually for some years.

Q. Approximately how many drilling firms are there today in the U. S.?

A. There are approximately 1000 U. S. rotary drilling contractors today. By way of contrast, we have records of over 1200 contractors in business in 1957. Percentage-wise, this is a reduction of close to 17% in four years.

Q. Any idea about the number of U. S. rotary rigs available for work?

A. There is a big difference of opinion on that. Many U. S. rotaries are not capable of

E. E. MONTEITH, JR. "Total demand . . . will increase to 11,975,000 bpd in 1970."

ROBERT C. SHARP "West Coast drilling outlook about the same as this year."

H. J. "Red" MAGNER "Deep gas potential makes Appalachian attractive for years."

ROBERT W. SNEED "Industry's economy drive has boosted air/gas drilling."

working and this number is increasing. Various figures have indicated the existence of around 3000 rotary rigs. My personal opinion is that 3000 is a little high. There are 2300 to 2400 rotaries working in the country now, and I think the industry would experience some difficulty if it were suddenly required to put another 250 rigs to work.

Q. What is the economic squeeze in which the contractor finds himself?

A. It is severe and results from several factors, the first being the large amount of idle time. Last year, rigs worked an average of 65% of the time. Another factor is the continued decrease in footage prices due to competition for jobs, while expenses, including taxes, continue to increase. The only thing the contractor has really been able to do to offset this situation is faster penetration. We have made some real strides in this direction.

Q. What percentage profit should a drilling contractor make on his investment after taxes?

A. In view of the risk and responsibility, I think the contractor should earn a net after taxes of about 8 to 10%.

Q. Do you think many contractors are getting this reasonable return today?

A. I don't believe very many are.

Q. Is there any practical answer to the critical problem of underbidding?

A. Contractors are just going to have to come around to the point of bidding on a basis that would bring them a reasonable profit. A standard bid specification sheet by the operators would help by spelling out what they expect the contractors to furnish.

Q. Accepting the fact that we can't alter significantly the operator practices in seeking bids and making drilling contracts, what are some of the other avenues that the contractor can take to combat the economic squeeze and still make a reasonable profit?

A. He should do his utmost to keep his equipment in good shape, employ skilled men and through these means improve efficiency in making penetration.

Q. How about other avenues of reducing his overhead and streamlining his organization such as some of the operators have experienced?

A. Drilling contractor organizations are relatively small, so it is more difficult to streamline, particularly when they are assuming more and more of the bookkeeping and other matters that operators formerly handled, such as third party services and supplies.

Q. Do you think this points to economic survival of contractors with more units working?

A. Possibly we will have some increase in the number of really large contractors but I don't believe we can anticipate any permanent disappearance of the small contractors. If they should go out for any period of time, once economic conditions show improvement they'll

(QA continued on page 118)

What We're Learning From

Bottomhole temperature in excess of 700 F persists as one of the most significant problems in drilling a 50,000-ft well, since it was discussed in Houston, Tex., two years ago by a panel of drilling experts.

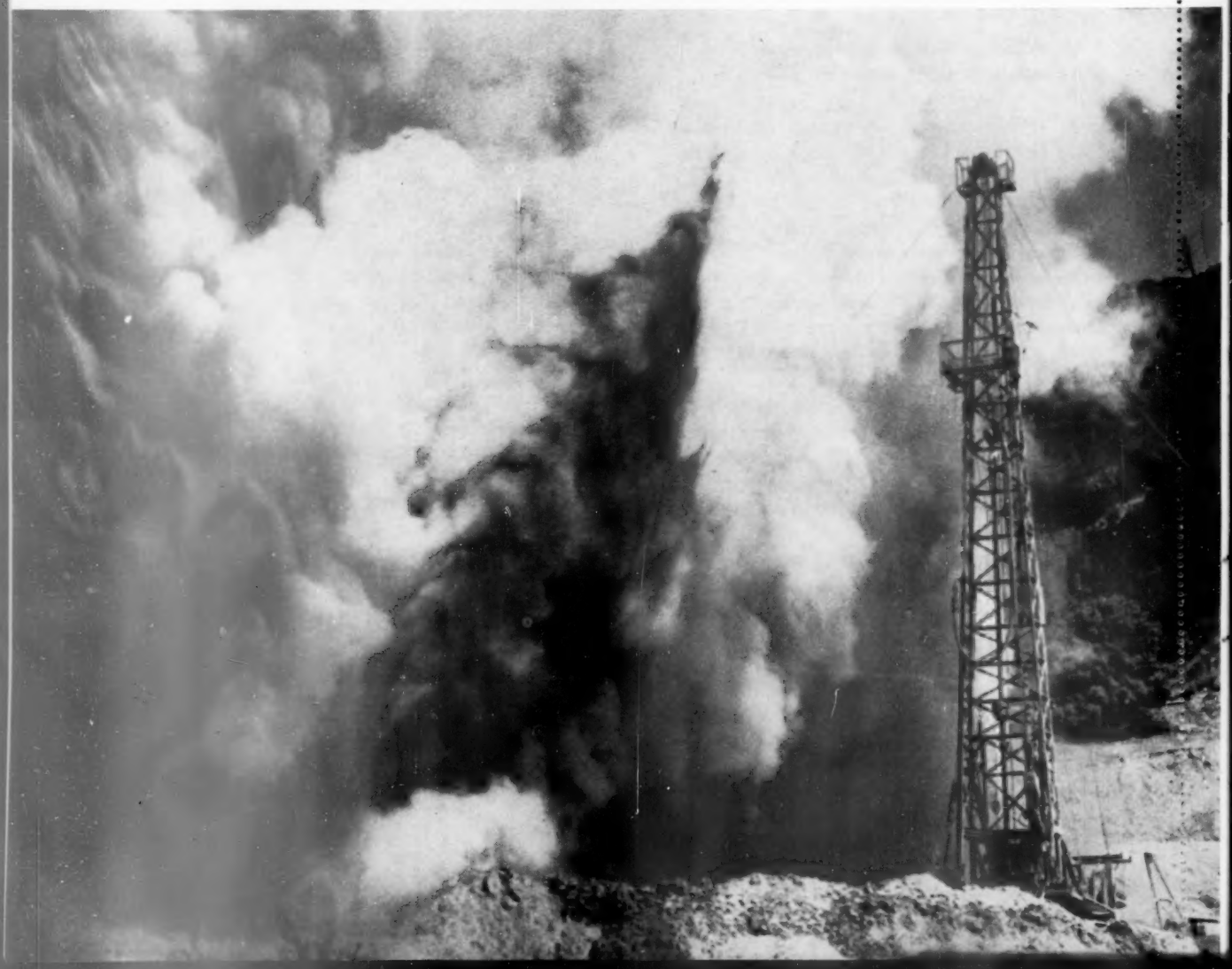
Editors of Petroleum Engineer, continuing to search for information that would indicate promising avenues for the drilling industry to follow to overcome such obstacles as extreme bottomhole temperatures in deeper wells... perhaps to 30,000 ft and beyond... have uncovered the fact that rotary drilling techniques have been used to drill several geothermal (steam producing) wells in Northern California. Although shallow, one of these wells blew out and cratered.

Engineering writer Arthur Langton of Los Angeles was commissioned to prepare a report on these operations.

Further editorial research revealed that a much deeper (4700-ft plus) steam well was drilled earlier this year in the Salton Sea area of Southern California. Joseph I. O'Neill Jr. of Midland, Texas, was the operator and E. T. Anderson, engineer for O'Neill, handled the technical and operating phases.

Technical accounts of both projects follow.

The Monster, a huge blowout at The Geysers, raged for nearly two years before finally being subdued.



Drilling Steam Wells

U.S. Geothermal Wells Are Now A Reality by Arthur Langton

Thanks to oil men, equipment and methods, electric power from geothermal steam has become a reality in the United States. Undoubtedly, for the part it has played and is continuing to play, the oil industry will be paid back with improved methods for use on future ultra-deep, high-temperature wells.

Pacific Gas and Electric Co.'s 12,500-kw generating plant at the Geysers, 90 miles north of San Francisco in Sonoma County, Calif., started producing June 28, 1960, to become the first privately owned utility of its kind in the world. It also marked PG&E as the first power company to produce electricity from four different sources—hydroelectric, conventional steam, atomic energy and geothermal steam.

The success of this enterprise has triggered drilling and leasing campaigns in many likely geothermal prospects in the West. In fact, since the initial PG&E plant has started to produce, construction has begun on an adjoining one of equal size, with completion scheduled for some time next year.

Oil field experience helped overcome many of the obstacles, although unusual or unexpected conditions cropped up at every turn. As one engineer summed it: "We knew little more than did Colonel Drake about what we were getting into. Fortunately, we were better prepared to cope with emergencies."

U. S. Areas of Promise

In this country the areas of possible geothermal development lie west of the easterly front of the Rocky Mountain system, which coincides significantly with areas of later Tertiary and Quaternary vulcanism. Outside of Yellowstone National Park there are some 700 known thermal springs in the western U.S.

As with oil shows, surface evidence of steam or hot water does not always indicate a location with commercial possibilities. Requirements for a source of commercially feasible geothermal energy have been expressed by L. C. Decius, consulting geologist for Thermal Power Co., as follows:

> Geothermal heat, to be of economic value, must be contained in gases or fluids as mobile carriers. If contained in gases, such gases must be under pressure sufficient to produce from wells and transmit to engines with adequate remaining pressure to drive the engines. If contained in water the temperature must be sufficiently high to flash off steam or permit heat transfer to some other media more adaptable for driving engines. For convenience, springs and thermal areas meeting the above requirements . . . (are) referred to as hyperthermal.

Of the 700 thermal springs previously mentioned, some 80 or 90 may be classed as hyperthermal. The association of most of these with Pliocene or Quaternary vulcanism strongly suggests a cause-and-effect relationship. As with oil wells, definitive proof of the commercial suitability of a hyperthermal prospect depends upon the actual drilling and testing of a well.

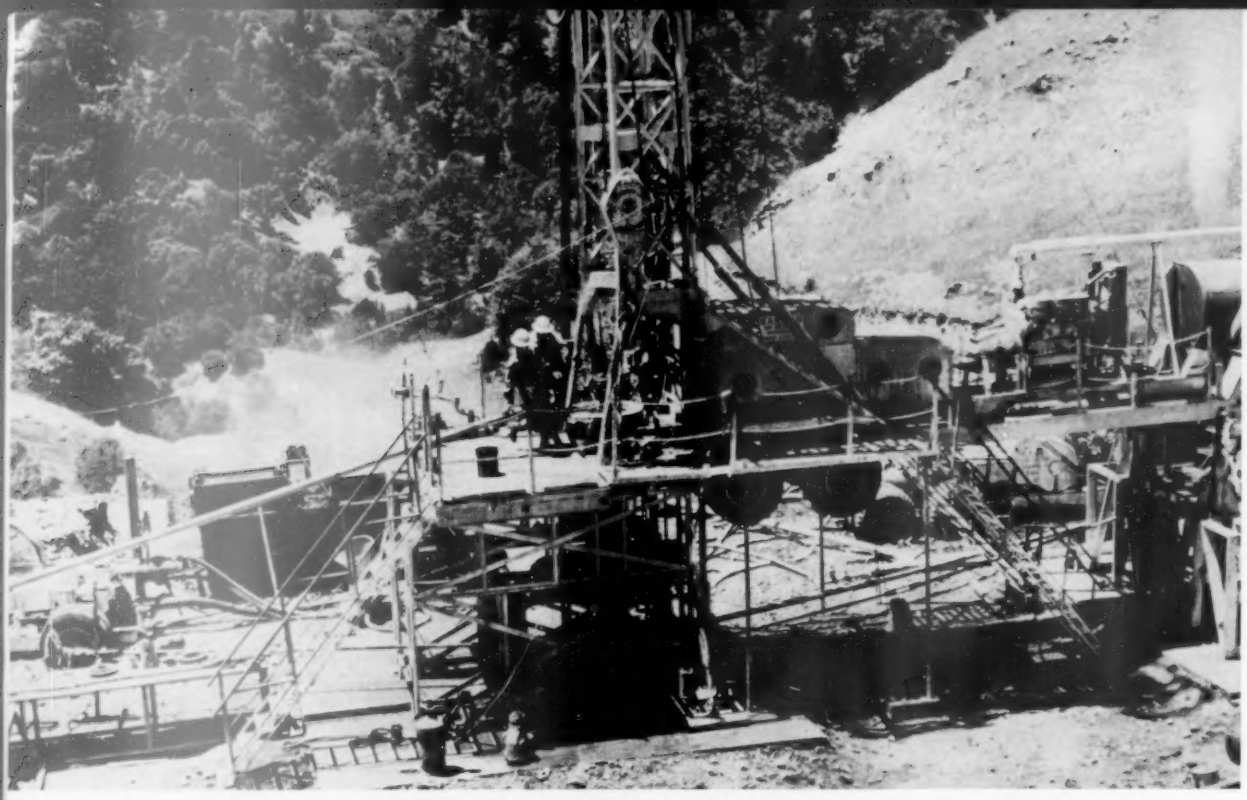
Origin and Composition

Generally it is agreed that geothermal steam is a mixed product consisting of groundwater steam and magmatic steam, the latter released directly from molten rocks. Differences of opinion arise as to the proportion of each, and it is quite possible that each geothermal area has a characteristic ratio.

At The Geysers in Sonoma County, the process of steam formation seems to be as follows: hot volcanic rocks at a relatively shallow depth heat adjacent water that mixes with gases and steam issuing from the volcanic rock itself to rise to the surface along channels made by intersecting faults.

The hydrostatic head of a column of hot water, as with any fluid, increases with depth, with a corresponding increase in the boiling point. At 1000 ft the boiling point would be 215 C (419 F) compared with 100C (212 F) at sea level. A shaft, such as a geothermal prospect, drilled into a formation carrying water at a sufficiently elevated temperature would release the pressure on the fluid enough to cause it to flash into steam as it escaped through the shaft.

At The Geysers the steam is superheated; that is, it is heated beyond the boiling point of water at the depth of its origin. Superheating,



Rotary equipment drills geothermal well at The Geysers development in Northern California.

particularly desirable from a power generation standpoint, indicates a high proportion of magmatic steam.

The Geysers' Beginning

The story of the development of The Geysers (actually fumaroles) stems back to 1921 when a visionary, J. D. Grant, employed cable tools to drill the first well. His difficulties can be imagined. But he did complete the well and run a string of casing equipped with a valve at the surface. When the valve was closed the whole string took off for outer space. Casing of the succeeding seven wells in the series was "cemented" in place with melted zinc, which proved equal to the task.

Grant could not market his product, so the project was abandoned. Luther Burbank had an interest in this premature development.

Some of these first wells continued to discharge steam with undiminishing vigor for the next 30 years as reminders that tapping a source of power is only part of the job, while harnessing and selling it is equally important.

In 1955, Magma Power Co. and its partner, Thermal Power Co., leased 3200 acres of likely looking "hot" hyperthermal prospect adjoining Big Sulphur creek in Sonoma County, where, by 1957, they had drilled six wells. On the basis of flow tests taken at this time, Pacific Gas and Electric Co. became interested and submitted a base price of 2.5 mils per kwh generated by the steam produced at this site by Magma and Thermal. A contract between the operating companies was signed, and on April 7, 1959, the Public Utilities Commission of California granted a certificate of public convenience to PG&E "to construct, own, operate, maintain and use the geothermal steam-electric generating plant and transmission project described in this Application No. 40641."

Other areas explored by Thermal and Magma include: Mammoth and Surprise Valleys, Calif; Beowawe, Brady and Steamboat Springs, Nev.; and Warner Valley, Ore.

Drilling Equipment

To drill at The Geysers and other western sites, Magma and Thermal used a modified diesel-powered core drilling rig with depth capability of 2500 ft. The kelly was hung in the derrick for ease of operation by the three-man crew. Drill pipe consisted of 40-ft stands of 4½-in. API. A multiple blowout preventer hookup provided security. A rotating blowout preventer was backed up by a set of pipe rams and a set of full closing rams.

At Steamboat Springs, Nev., an elaborate mud system proved successful in combating high downhole temperatures. A surfactant mud

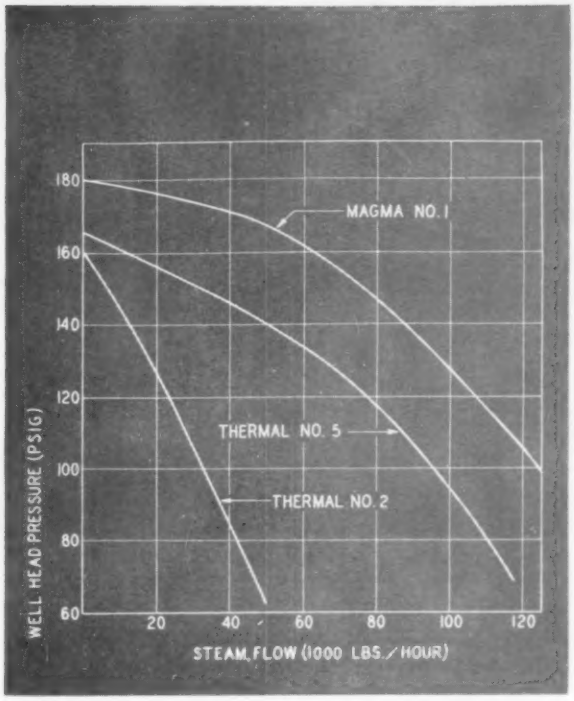
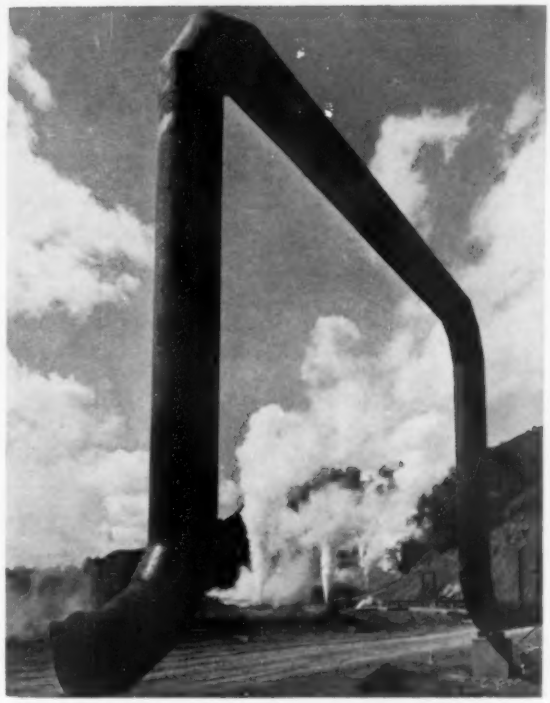


Chart A shows relationship of pressure and flow rate typical of steam wells.



Steam line under construction will transport steam from well blowing in the background.

weighing between 9.6 and 10 lb per gal (72 and 75 lb per cu ft) with 44-sec viscosity was cooled through 800 ft of 2-in. line submerged in water. Two blowoff lines, an 8-in. and a 3-in., were part of the mud layout.

At The Geysers less attention was paid to the mud, probably because of a chronic lost circulation problem. In fact, part of the drilling was accomplished with no returns as the bit encountered faulted and shattered rock. Formations drilled consisted mainly of well-indurated medium to fine-grained sandstones with minor thin, dark shale members, cherts, greenstones altered from basalt and serpentines derived from ultrabasic intrusive masses.

Casing program at The Geysers included a short string of 20-in. conductor pipe followed by 13⅜-in. landed at a spot determined by continuous coring below 200 ft. This depth varied between 285 and 398 ft. Drilling continued with a 12¼-in. hole to a barefoot completion somewhere between 745 and 952 ft. The large hole sizes of the six wells completed in this manner were chosen to encourage the flow of steam.

Casing was cemented to the surface wherever possible to counteract casing creep because of high temperatures. Neat cement was used in the initial well in this series with surprising, if not beneficial, results. The slurry turned into concrete golf balls when exposed to the high temperatures below ground. A pozzolanic cement provided a much better cement job on succeeding wells.

Problems Encountered

Illustrating the potential for trouble ever present on these wells, Thermal No. 4, drilled on a bench about 100 ft from a steep embankment falling away from the well site, blew out through the side of the slope. A relief well managed to intersect the pressure zone to allow large quantities of lost circulation materials to be pumped into the formation. The blowout quit suddenly. But the bridge proved only temporary. The formation exploded—blasting mud, rocks, water and volcanic debris 700 ft in the air. In its renewed form, the blowout dwarfed its previous state by far.

When the explosion occurred, the rotating blowout preventer of the relief well was above the rotary table for repairs while a length of pipe was left in the hole. As the relief well started to blow a crew member managed to give the ram control a turn before steam drove him away. This closed the pipe rams only partially, but enough to lock the pipe in the hole and prevent the other set of rams from being closed. Then the drilling line and blocks broke loose

Test stand is used to determine flow characteristics of geothermal wells at The Geysers.

and fell to the derrick floor. Fortunately, everyone escaped injury.

This new blowout was named the Monster. The sound alone prevented men from working nearby for more than a few minutes at a time, even though they were equipped with ear caps. Communication had to be by written message.

While every available piece of equipment in the area was mobilized to pump cement and to push rocks and dirt into the crater, work began to gain control of the relief well. The crew gained access to the control valve of the pipe rams and opened them, thus freeing the drill pipe. With no restriction on the steam, the derrick floor now became completely untenable, but by this time the drilling line and block situation had been straightened out sufficiently so that pipe could be pulled from the hole if the pull were applied from the fast end of the drilling line.

The only avenue of approach was from the top of the derrick, the only place from which steam could be diverted. In one of the nerviest oil field performances of the year, a man climbed along the outstretched boom of a mobile crane and crossed over to the relief well derrick, where he managed to secure a line from a tractor to the fast end of the drilling line. As the tractor pulled away, line was taken up and the pipe was pulled from the hole, enabling the rams to be closed. Guy lines to the derrick prevented it from being toppled by the pull of the tractor.

It took two years of effort to bring the Monster under control.

A short time after the operations described above, a whole section of ground from which the relief work had been conducted collapsed and fell 90 ft into an underground cavern, apparently created by the blowout. Again, no one was hurt.

The Completions

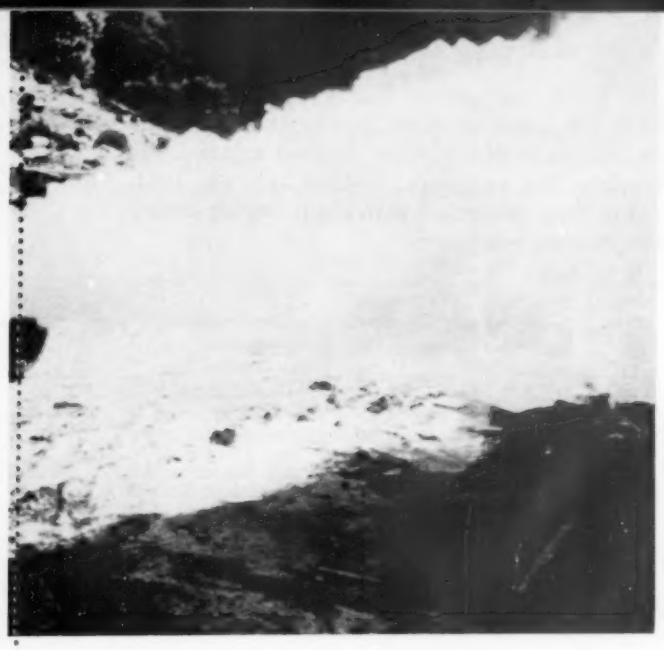
Wells were completed with a manually controlled valve at the surface. It is a characteristic of steam wells that flow volumes determine pressure. This is demonstrated in Chart A which shows drop in pressure with increase in steam flow. Table 1 shows the relationship between steam flow and enthalpy (heat content) at 115 psig, the wellhead pressure selected to operate the turbine installation.

TABLE 1.

	115 psig at steam wells	
	Steam flow, lb/hr	Enthalpy Btu/lb
Magma No. 1	111,000	1207
Thermal No. 5	82,000	1199
Thermal No. 2	26,000	1204
Total for three wells	219,000	

The trick in a successful geothermal operation is to determine the optimum combination of volume, pressure and temperature to produce the most electrical energy. Under ordinary circumstances, turbines and steam sources are designed to match each other according to well-established formulas. At The Geysers, elaborate measurements of flow rate and enthalpy were taken, but the final hookup to the turbine-generator was accomplished by some finger-crossing.

The turbine selected operates at 100 psig, the pressure drop along the 1300 ft of steam line accounting for the difference between the turbine pressure and the wellhead pressure. The consumption of the first 12,500 kv generating unit is about 250,000 lb of steam per hr.



Corrosion proved a major factor in plant design. Corrosimeter tests on a pilot plant showed the relative rate of corrosion for various metals as summarized in Table 2. The metals are listed in increasing order of cost.

TABLE 2.

	Corrosion rates in Mils per year			
	Carbon steel	Type 410 SS	Type 304 SS	Type 316 SS
Turbine exhaust duct	10.95	0.31	1.06	0
Pipe to gas ejector	49.6	1.25	1.06	0.58
Gas outlets from after-condenser	86	—	—	—
Condenser hotwell	171.5	0	2.82	0

As a result of these tests main condensate lines were made of Type 304 (18% chrome, 8% nickel) stainless steel pipe, exhaust duct of Type 304 stainless steel plate, and main barometic condenser of clad Type 316L stainless steel plate. In subsequent checks no significant corrosion was observed except in some exposed copper and brass fittings.

Even now, as the oil industry evaluates what has been learned about geothermal drilling, more information is being brought to its attention. Recently, what is probably the deepest geothermal well and the hottest well bore in the world was completed in Southern California. Drilled to produce steam to generate power, it encountered downhole temperatures of about 700 F and provided a sampling of what has to be met in future 50,000-ft oil and gas wells.

Reference

Decius, L. C., GEOLOGICAL ENVIRONMENT OF HYPERTHERMAL AREAS IN CONTINENTAL UNITED STATES AND SUGGESTED METHODS OF PROSPECTING THEM FOR GEOTHERMAL POWER. From United Nations Conference on New Sources of Energy, April 22, 1961.

How World's Hottest Hole Was Drilled

by E. T. Anderson

In Southern California's Imperial Valley, 200 ft below sea level, O'Neill, Ashmun and Hilliard have completed Sportsman No. 1 at 4737 ft — probably the deepest geothermal well and the hottest well bore in the world.

Drilled near the southeastern shore of Salton Sea to produce steam to generate power, this project encountered downhole temperatures of about 700F, similar to those to be met in future 50,000-ft oil and gas wells. Already some of these conditions have been hinted in current deep oil wells.

Encouraging to future deep drilling was the excellent performance of both cement and drilling mud under the extremely elevated temperature conditions of Sportsman No. 1. This geothermal well, as do others, owes much to petroleum equipment and methods, but the information derived will help to repay the debt.

Imperial Valley's Geology

Geothermal manifestations such as bubbling mud pots, fumaroles, and carbon dioxide wells have made this part of Imperial Valley geologically noteworthy for many years. Presence of the San Andreas fault to the north, the Obsidian fault to the west and molten magma at between 8000 and 10,000 ft indicated presence of geothermal steam.

Formations encountered in drilling include multicolored clays, sandstones and siltstones, all young and highly fractured. The only core, taken near total depth, showed all of its fractures to be filled with pyrite. Although opinions differed, to consensus maintained that the rocks drilled were of Miocene age.

Differing from other geothermal areas, the thermal gradient at this location appeared to follow a straight line on the order of 13 F per 100 ft. This agreed with the extrapolated 675 F bottomhole temperature at total depth.

Casing, Cement Programs

Information from other areas where steam is found at depth indicated the prime importance of keeping the bore hole cool. Therefore, equipment capable of circulating 1000 gal of

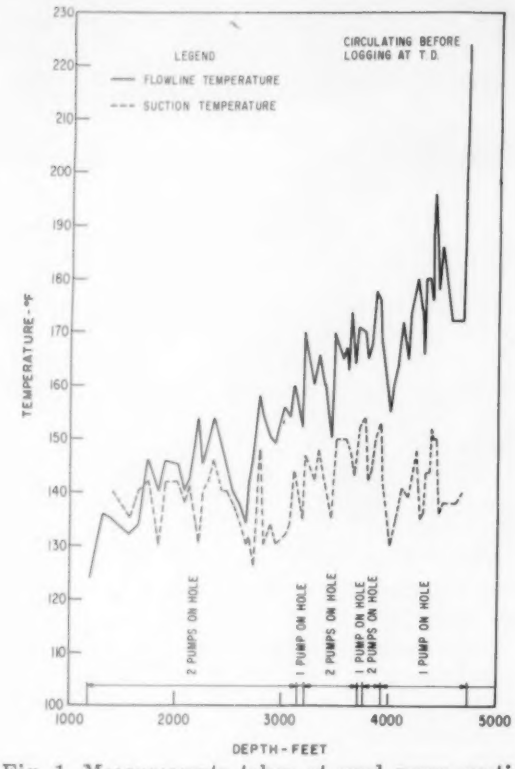


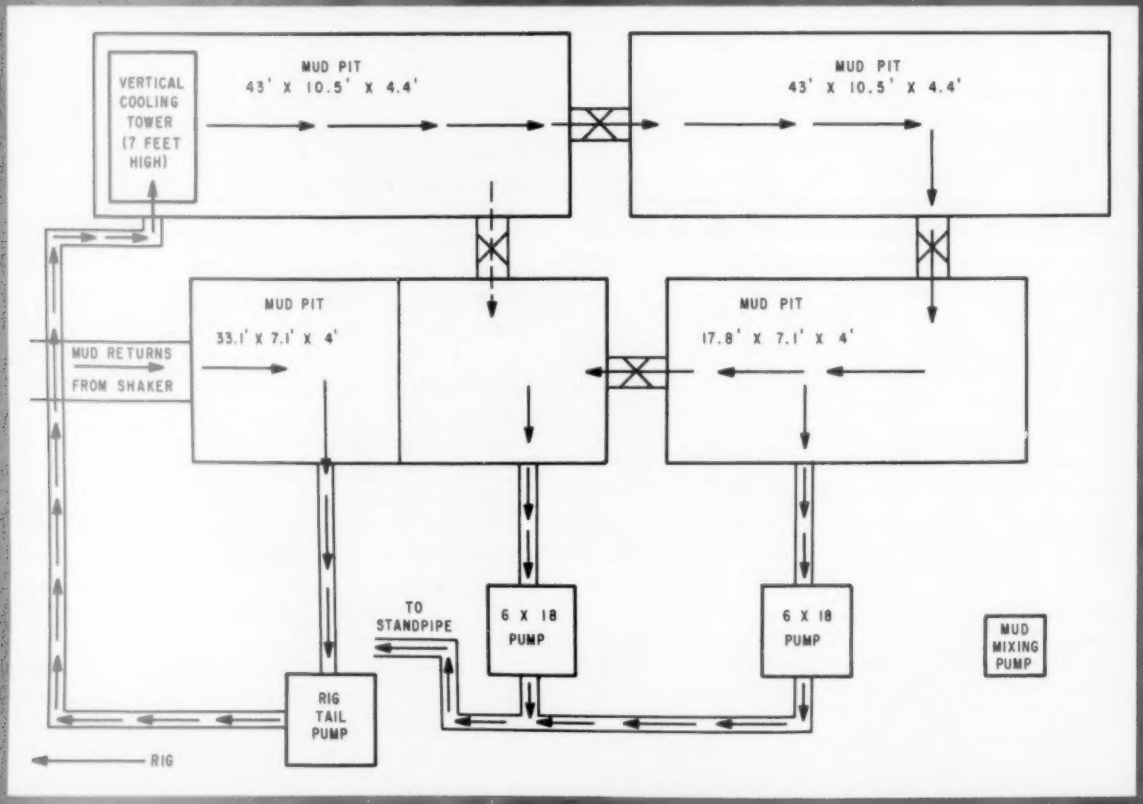
Fig. 1. Measurements taken at mud pump suction and mud flowline reflect high temperatures involved in drilling Sportsman No. 1. (Courtesy Baroid Div.)

mud a minute at 5000 ft was installed. The rig, of the 10,000-ft class, utilized a jack-knife derrick. The well was spudded Jan. 26, 1961, and drilling proceeded with the following casing and cement program:

Pipe size-in.	Pipe specifications	Setting depth-ft.	Cement used—cu ft
20	Conductor	65	402—regular
16	65#, J-55, ST&C	289	460—40% silica flour
10¾	45.5, J-55, ST&C	1,195	1300—40% silica flour and retarder
5½	17#, N-80, Xline	4,729	DV collar at 2444 ft; first stage, 1182 with 40% silica flour and retarder; second stage, 1800 with 40% silica flour

A major problem was the choice of cement to resist the elevated temperatures to be encountered. Experience and laboratory work demonstrated that regular cement retrogressed very rapidly under high temperatures, and that pozzolan types, while superior to neat cements, still would not be satisfactory. Should the cement job fail on this well, the casing would elongate as much as 3 ft per 1000 ft of uncemented string.

It was decided, therefore, to use Class E cement with 40% silica flour and a retarder.



This combination showed the least amount of strength retrogression in laboratory tests and provided a slurry with the following properties:

Water ratio:	6.30 gal per sack
Weight:	15.87 lb per gal
Volume:	1.55 cu ft per sack

There was little evidence of cement failure in the well, although the longest geothermal steam flow to date has been 3½ days. Maximum wellhead rise due to casing creep has been 2½ in.

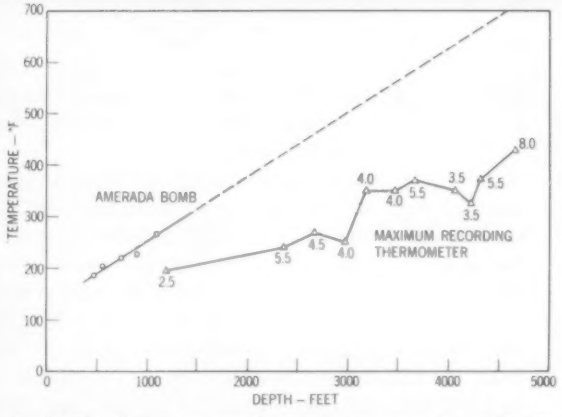
The casing elongation factor eliminated possibility of using standard API flanged wellhead equipment that would allow for no casing creep. Selected wellhead and associated casing equipment were designed for 700 F at 2100 psi. The wellhead was based upon the old style "Louisiana pattern" casinghead that packed off around the inner strings by means of a packing gland. This type of gland was improved and a second added to allow repacking of the upper section under pressure in case of casing failure in the 5½-in. string during production. The assembly was then beefed up to be equivalent to API Series 1500 equipment.

Floating equipment in the casing was redesigned in cast iron to eliminate rubber seals in the floats. X-line casing, with joints that "shoulder," was chosen to eliminate possibility of hoop failures that are common in compression conditions at elevated temperatures.

Trouble Occurs

The only serious accident during drilling occurred in connection with the use of the two-stage cement tool in the 5½-in. string. Lost circulation had been encountered and the breakdown pressure in this section dictated the need for a two-stage program.

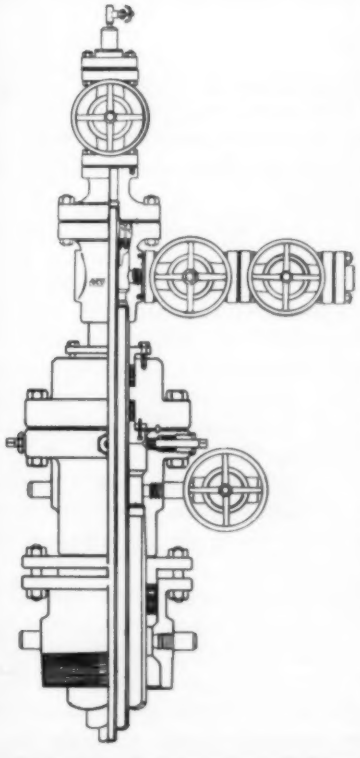
No trouble was encountered until after both stages had been allowed to set and the cement and the two-stage tool were being drilled out. The fluid inside the 5½-in. string in the lower section had been increasing in temperature from the time of completion of the second stage until drillout time. Use of retarded cement also considerably extended the waiting-on-cement time. When the bit had reduced the cement plug in the hole to about 2 ft in thickness, the pressure below moved the cement plug up the hole far enough to unload the kelly and one



Bottomhole temperature measurements vs depth in Sportsman No. 1 showing comparison of two techniques. Data for top curve taken with Amerada-type temperature bomb after casing had been set and mud static 75 hr. Data for lower curve taken with maximum-recording thermometer. Numbers indicate hours mud was static before measurement.

Flow diagram of circulating system on Sportsman No. 1 shows relative location of mud system components and main path of mud flow.

General wellhead hookup designed to allow for casing creep in Sportsman No. 1. Actual tree set did not include tubing string or tubing head valves.



Completed Sportsman No. 1 has high-pressure and large-diameter, low-pressure separators.

joint of 2⅞-in. drill pipe. As soon as the expansion pressure was released, the blowout was over. In future geothermal wells, use of other types of two-stage equipment is planned.

Mud a Major Factor

A major factor in the successful drilling of Sportsman No. 1 was the drilling mud that had to stand up when exposed to 700 F temperatures. Mechanical equipment included a 7-ft wooden cooling tower with electrical fan-type blowers for cooling air circulation. Mud was pumped to the tower, allowed to fall through it, then sent through two storage pits before being pumped back down the hole. Recording thermometers were installed at both flowline and suction.

Water losses were high due to high flowline temperatures (ranging from 160 to 224 F) and the location of the well in one of the hottest and most arid portions of the United States. Consequently, large amounts of makeup water were required while drilling to provide low viscosity and to prevent mud density increases, even though the formations being drilled were not of the mud-making type.

A conventional gel-forming bentonite mud treated with a free-flowing organic powder and caustic soda was used to drill to 2690 ft where increasing temperature increased water loss. At this point conversion to sodium surfactant mud was begun by the addition of 2400 lb soda ash, 4900 lb organic powder, 400 lb caustic soda, 1380 lb surfactant and defoamant, and 400 lb salt to the 800 bbl of mud. As drilling proceeded, the conversion was completed by adding 15,000 lb organic powder, 1300 lb caustic soda, and 3220 lb surfactant and defoamant.

Except for lost circulation cured by the addition of fragmented plastic foil and fine walnut hulls, there were no further mud problems.

Mud properties with the well near total depth and with flowline temperature of 183 F were:

Weight:	10.3 lb per gal
Viscosity:	34 sec per qt
10-sec gel:	0 lb per 100 sq ft
10-min gel:	9 lb per 100 sq ft
API filtrate:	2.5 ml

Fig. 1 shows the curves of flowline and suction temperatures with depth. Note that the two curves diverge with depth even though the mud was being cooled, which reflects the increasing Btu output of the well bore and the fact that the cooling equipment being used was approaching its depth limit for the temperature gradient involved. A blowout cycle can be started, of course, whenever the return mud reaches its flash temperature, which in this case was approximately 230 F. Unloading in the annulus will reduce the static weight and enable the mud to flash at a lower pressure.

Taking the Temperature

Determining bottomhole temperature posed an interesting problem. Continuous mud circulation needed to keep the well under control exerts a tremendous cooling effect on the well bore, making it impossible to take a direct reading of the true temperature.

Data obtained from geothermal wells drilled at Wairakei in New Zealand showed that, after quenching, these bores would return to approximately 60% of their true bottomhole temperatures in about 4 hr. With this information as a basis, practice of returning drill pipe open-ended to 100 ft off the bottom of the hole was followed when pipe had to be pulled to change the bit. Four hours after circulation had stopped, temperatures were taken either with an Amerada-type bomb or with maximum reading thermometers.

The figures taken in this manner were extrapolated to 100% for bottomhole temperature computation. Later tests showed that this system gave the true temperature with reasonable accuracy.

What the Well Produced

After completion, the well was allowed to flow for 3½ days during which it produced 57,000 lb of dry steam and 258,000 lb of hot water per hr at wellhead conditions of 200 psig and 400 F. The water is highly mineralized and could prove very valuable from the standpoint of mineral byproducts.

Testing is still taking place in an effort to evaluate the potential of this newly-found geothermal area.

The authors and Petroleum Engineer thank Pacific Gas & Electric Co., Thermal Power Co., Magma Power Co., Halliburton Co., Baroid Div. of The National Lead Co. and Oil Center Tool Co. for technical data, illustrations and their cooperation.

■

Cost Analysis of Drilling Materials on Sportsman No.1 Geothermal Mud in Imperial Valley

Materials used to drill to 2690 ft:

Material	Amount	Cost
Aquagel	12,800 lb	$ 291.07
Baroid	16,300 lb	$ 333.50
Carbonox	9,750 lb	$ 1076.40
Caustic soda	1,700 lb	$ 181.05
	Total	$ 1882.02
Cost per day (11 days)		$ 171.10
Avg. cost per barrel based on 550 bbl		$ 3.42
Avg. cost per barrel per day		$ 0.31
Cost per foot drilled		$ 0.70

Materials used for conversion to sodium surfactant mud:

Material	Amount	Cost
Carbonox	19,900 lb	$ 2196.96
Caustic soda	1,700 lb	181.05
Soda ash	2,400 lb	100.80
Salt	400 lb	12.00
DMS	4,600 lb	1702.00
Baroid	9,000 lb	184.14
	Total	$ 4376.95
Cost per barrel (final volume of 800 bbl)		$ 5.47

Cost to build 300 bbl new volume due to lost circulation:

Material	Amount	Cost
Aquagel	9,800 lb	$ 212.85
Carbonox	7,500 lb	717.60
Caustic soda	700 lb	74.55
Soda ash	400 lb	16.80
Salt	900 lb	27.00
DMS	460 lb	170.20
Jel Flake	1,050 lb	334.32
Fine walnut hulls	3,000 lb	300.00
Fine Micatex	1,750 lb	162.75
	Total	$ 2016.07
Cost per barrel (300 bbl volume)		$ 6.72

Materials used while drilling from 2690 ft to 4729 ft:

Material	Amount	Cost
Carbonox	13,750 lb	$ 1518.00
Caustic soda	2,500 lb	266.25
Soda ash	1,900 lb	79.80
Salt	1,700 lb	51.00
DMS	4,600 lb	1702.00
Jel Flake	650 lb	206.96
Fine Micatex	4,250 lb	395.25
Fine walnut hulls	2,750 lb	275.00
Fibertex	2,200 lb	235.40
	Total	$ 4729.66
Cost per day (12 days)		$ 394.14
Avg. cost per barrel based on 900 bbl		$ 5.98
Avg. cost per barrel per day		$ 9.50
Cost per foot drilled		$ 2.31

Total cost including maintenance, conversion, and lost circulation:

Maintenance to 2690 ft	$ 1,882.02
Conversion	$ 4,376.95
Maintenance from 2690 ft to 4729 ft	$ 4,729.66
Lost circulation	$ 2,016.07
Total	$13,004.70

The above prices are approximate and do not include taxes or drayage.

High tides inundate steam land rig just inland from Vermilion Bay which covered production facilities.

Ten-ft tide and 20-ft waves undoubtedly caused water damage to this submersible in the Eugene Island area.

First reported lost, Penrod's multi-million dollar Rig 52 was found in the Vermilion area after being washed many miles off location.

HURRICANE CARLA

Offshore structures and inland oil operations took a beating from Hurricane Carla. But when the high tides, winds exceeding 100 mph and lashing waves had subsided, early estimates indicated damage was far less than expected.

Two days after the hurricane hit, the writer made an aerial survey of Louisiana coastal and offshore facilities from East Cameron to South Pelto and extending some 40 miles into the Gulf.

That little structural damage was suffered reflects the sound engineering and design of these facilities. Tides over 10 ft and waves over 20 ft completely covered some offshore submersibles, inflicting water damage. Since most offshore rigs are diesel-electric powered, most damage is probably in the electrical systems.

Production platforms were undamaged structurally. Inland barges appeared unharmed, and we noted many were already back at work.

Penrod Drilling Co.'s Rig 52, reported missing Sept. 13, was located and photographed the next day.

Along the Texas coast, few offshore operations were in progress. Inland drilling was shut down tight.

A big problem to contractors, especially along the lower Texas coast, was getting drilling crews together to make needed repairs. They had evacuated the area with their families, and contractors could do little but wait until they reported back to work.

■ — J. E. KASTROP.

Offshore production facilities appeared in good shape as helicopter brought workmen back to structure.

Floating operations underway some ten miles off Vermilion Parish to take rig back to drilling site.

Kelly with barrel assembly on bottom is stabbed over mandrel on drill string used to drill anchor holes on offshore structure.

by J. E. Kastrop

Threadless Drill Pipe Tool Joint: A Progress Report

A threadless drill pipe tool joint, though not yet proved out for commercial use in routine drilling operations, has achieved notable success in a variety of limited field applications.

The idea, which offers the first major change in drill pipe joints from the standard threaded connection and conventional methods of making up and breaking out such a joint, was first advanced about three years ago.

The idea is an adaptation of a patented principle used in an existing and proven safety joint called the right-hand torque releasing safety joint by Shaffer Tool Works of Brea, Calif., who manufacture and offer the device to the drilling industry. Though primarily a safety joint, it has been used successfully in sub-sea completions. With this type of joint, it's possible to disengage simply and quickly the drill pipe from the casing assembly after cementing pipe, as well as to engage it again for subsequent drilling and testing operations.

Latest prototype of the new threadless drill pipe tool joint employs the identical principal of operation as the existing model of Shaffer's right-hand torque releasing safety joint. Primary difference between the safety joint and the drill pipe tool joint version is the method of releasing the joint.

The safety joint employs a releasing rod that is lowered inside the drill pipe to disengage a locking mechanism. The tool joint version is released by a simple lever which engages the releasing mechanism through a small vertical slot in the joint housing.

How the Threadless Joint Works

There are two basic parts to Shaffer Tool's threadless (author's terminology) drill pipe tool joint — the mandrel and the barrel assembly. The mandrel is an integrally-machined tubular extension that fits inside the barrel assembly (see Fig. 1). Three steep helical slots equally spaced around its outer surface are machined on the mandrel as shown in Fig. 2. An extension or guide tube on the end of the mandrel serves to aid in joint alignment as well as to contain three O-ring grooves at the end of this tube. These O rings serve as the primary pressure seals for the joint.

Several different ways to make a pressure tight seal have been tried and the O-ring design

in an emergency...

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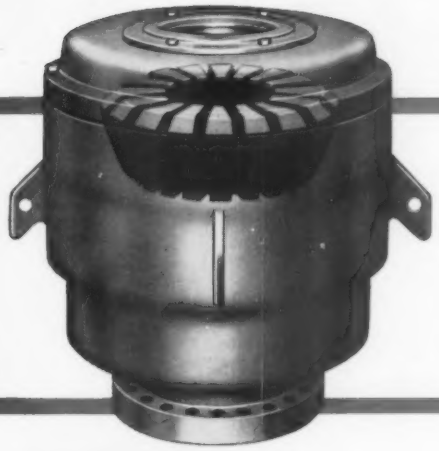
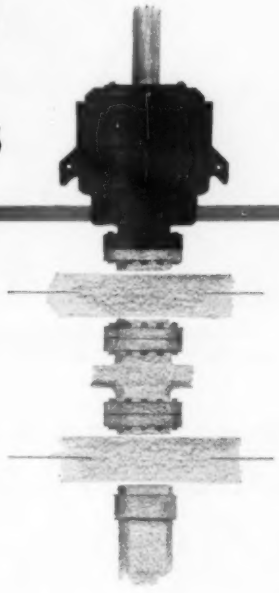


HYDRIL
BLOWOUT PREVENTERS



And when "what's on top" is a Hydril Blowout Preventer, you *know* you can shut off your well in a jiffy when the need arises... no matter what member of the drill string is in the preventer... no matter if there is *nothing at all in the hole!*

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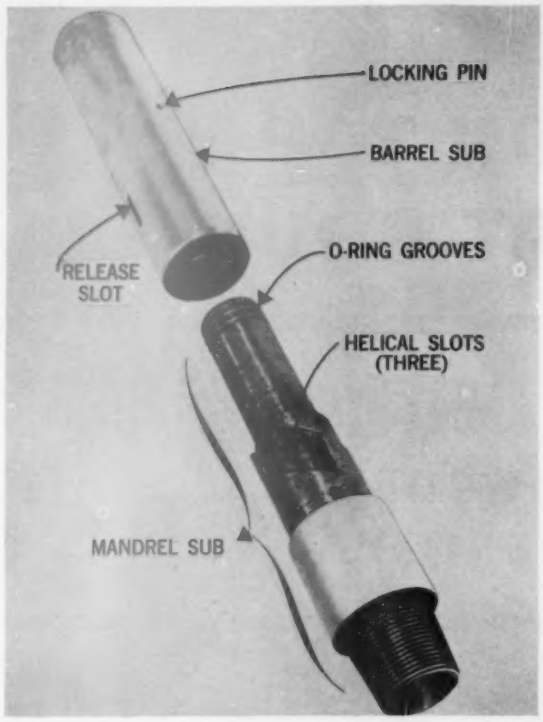

FIG. 1. Two major components of the threadless tool joint are the mandrel sub and the barrel sub.

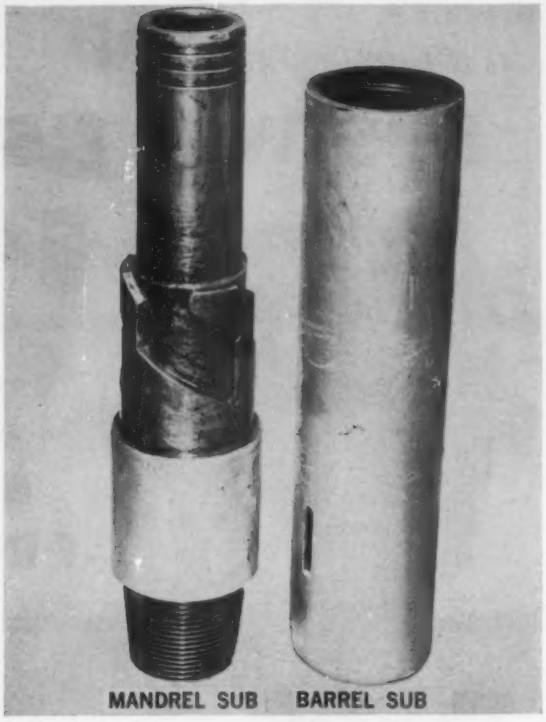

FIG. 2. Each sub of one recent test joint is equipped with an API drill pipe threaded pin and box.

appears to be best at the present stage of development.

The barrel assembly is made up of three primary parts — the outer barrel itself, a key sleeve with three integral locking lugs, and a spring case which houses four helical coil springs.

Three keys are machined in the inner surface of the barrel as shown in Fig. 3. These keys serve to transmit torque and to shoulder a sliding key sleeve which locks the mandrel to the barrel.

This key sleeve is a circular band with three equally spaced lugs or fingers that give the key sleeve an appearance of a widely-notched machined collar. It rides on guides inside the barrel. The key sleeve is held in position by means of a spring case. This spring case (see Fig. 5) resembles a sliding barrel that fits snugly inside the barrel. It contains four helical coil springs that force the spring case against the key sleeve, tending to force it against the keys.

The key sleeve and spring case are held in position inside the barrel by threaded locking pins screwed into the barrel as indicated in Fig. 4.

Making the Connection

Making a drill pipe connection is as simple and quick as stabbing the conventional API tool joint. As soon as barrel is lowered over the mandrel, it makes a quick third turn and the connection is made.

Here's what happens. As the barrel is lowered over the mandrel, the three keys machined into the inner surface of the barrel mate with the three helically-cut slots in the body of the mandrel. These keys follow the slots until the barrel is as far down over mandrel as it can go.

When this position is reached, a set of locking lugs on the key sleeve within the body of the barrel becomes aligned with a set of vertical grooves in the mandrel, allowing the key sleeve to drop into the locking position where it holds the barrel keys in place. The four springs keep the key sleeve pressed into the locking position to prevent the barrel keys from rotating out of the helical slots in the mandrel.

Making this connection is extremely simple. In fact, it is not even necessary to rotate the barrel as it is lowered over the mandrel. The steep slope of the helix is sufficient to cause the barrel to move into proper position by rotating it about a third of a turn. The two parts cannot be over tightened or jammed. And, once locked together, the joint will not separate by rotation in either direction, by compression or tension.

A complete pack-off is achieved by three O-rings on the end of the mandrel that seat

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Packer Accessories? Baker offers a complete line that makes the packers more usable and adaptable. Dual and triple string flow tubes, for instance, and plugs and other accessories.

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*10 Modern Production Packers

Single-Zone? Multiple-Zone? Water-Flooding? Deep Wells? Shallow? High Temperatures? Formidable Pressures? ■ The ten packers pictured here handle an impressive array of tough and simple production jobs.

*If you count the pictures, you come to number 10. But that's certainly not the total of packers made by Baker. For instance, Models "J" & "K" Snap-Set Packers are also made in double-grip versions. The Model "R" is also offered in a single-grip type. A compression packer is available. Moreover, thanks to Baker's continuing program of packer research and development, new packers that will supplement the packers pictured above are coming.

Drillable

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Related design to Model "D". Contains larger continuous bore than Model "D" Used where extra large bore is required in some parallel (triple) string, flowing or pumping hookups.

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These are Retrievable

BAKER MODELS "J" AND "K" SNAP-SET DUAL PACKERS

Used as the upper retrievable packers in two or three-packer, parallel-string installations. Provides largest full-opening bores possible. For instance, 7" size has full opening for two 2⅜" tubing strings. Actuated by set-down weight only, and can be set and released as many times as required. Short string can be run and retrieved separately. Model "J" is long-string set; Model "K" is short-string set. Also available are Double-Grip versions that contain built-in, button-type, hydraulic hold-downs.

(left)
Model "J" Single-Grip Snap-Set Dual Packer
Product No. 756-J

(right)
Model "K" Single-Grip Snap-Set Dual Packer
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BAKER MODEL "M" SNAP-SET PACKERS

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FIG. 3. Inside view of the barrel shows some of the design features. Three barrel keys are an integral part of the barrel itself.

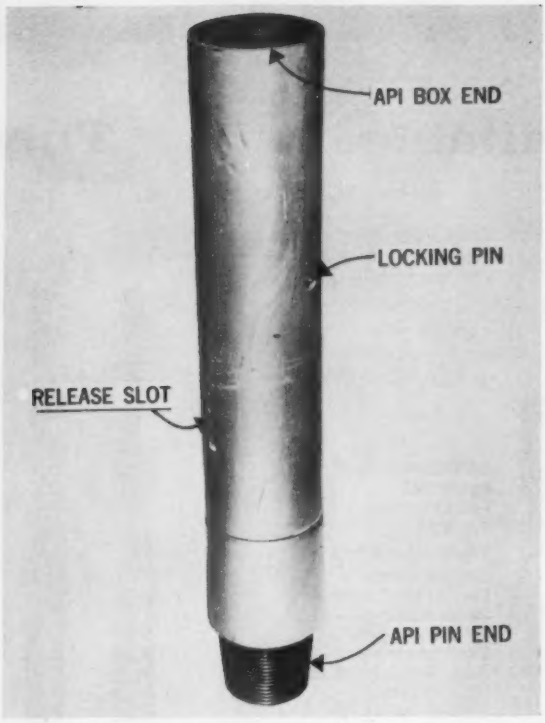

FIG. 4. Made-up joint showing releasing slot through which a disconnect tool engages the key sleeve to release it from its locking position.

against a machined surface inside the barrel. There is also an O-ring element at the mouth end of the barrel (see Fig. 5) which seals against the base of the mandrel.

Breaking the Connection

Although the mandrel and barrel portions of the Shaffer threadless drill pipe tool joint lock together into an integral unit that withstands torque, tension and compression, the two parts can be separated easily by use of a special disconnect tool. A vertical slot in the barrel provides access to one of the locking lugs on the key sleeve so that the locking lugs (which are an integral part of the key sleeve) are lifted out of the locking position. To lift the key sleeve, it is necessary to overcome the compression of the four springs in the spring cage that keep the key sleeve in the locking position.

The key sleeve is lifted out of its locking position by leverage provided by the disconnect tool, which resembles a small bar about 24 in. long. One end is inserted into the vertical slot in the barrel until it engages the locking lug inside the barrel. By forcing the key sleeve against the spring cage until it moves the locking lugs from the locking position, the barrel is free to disengage from the mandrel. Actually, a small amount of tension in the pipe when the connection is broken causes the barrel to rotate a quarter of a turn as the barrel keys ride back out of the helical grooves in the mandrel. At this point, the barrel is disengaged immediately from the mandrel.

Stage of Development

Adaptation of the Shaffer right-hand torque releasing safety joint as a drill pipe tool joint has come through many stages of development and experimentation. Although the joint has been made in several different sizes and for several applications, it is still in the development stage. The tool joint versions tried so far are nearly custom-made for each particular use. Several development models of the joint have been used in drilling strings for tool joint service.

One design of the new joint is shown in Figs. 1, 2, 3 and 4. Design of each portion (mandrel and barrel) is in the form of a sub which can be screwed onto existing drill pipe. The API pin is on the mandrel sub while the API box is on the barrel sub. When connected to standard drill pipe, the mandrel looks up and the barrel is stabbed over the mandrel.

Some Recent Tests and Uses

During the earlier phases, one joint was used to drill parts of two wells for Phillips Petro-

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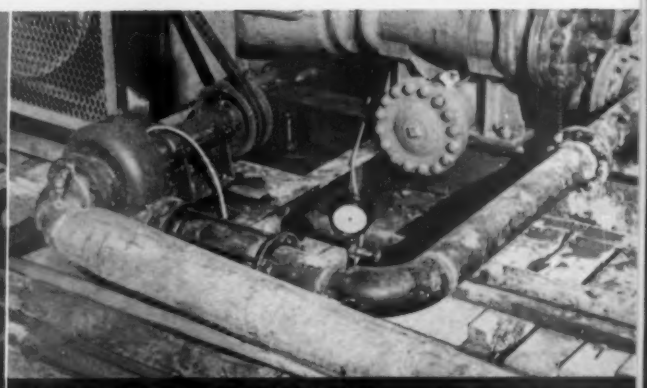

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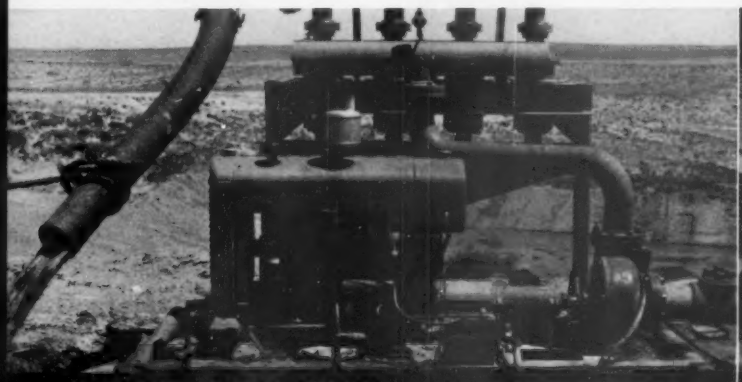

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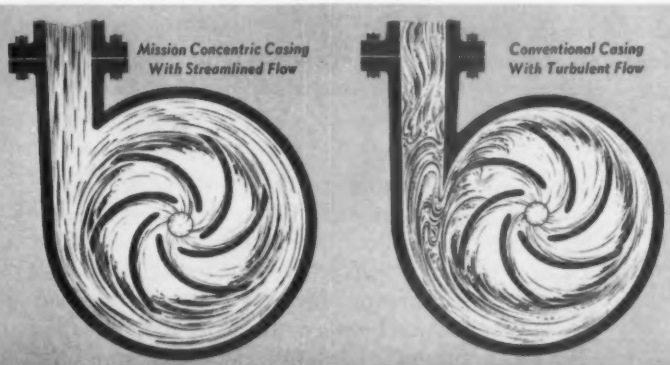

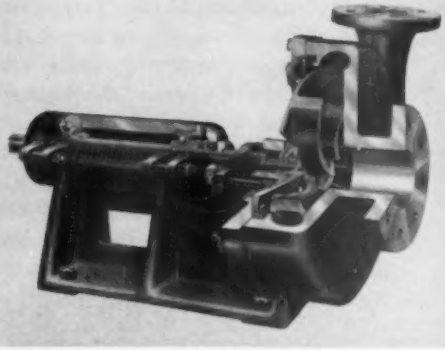

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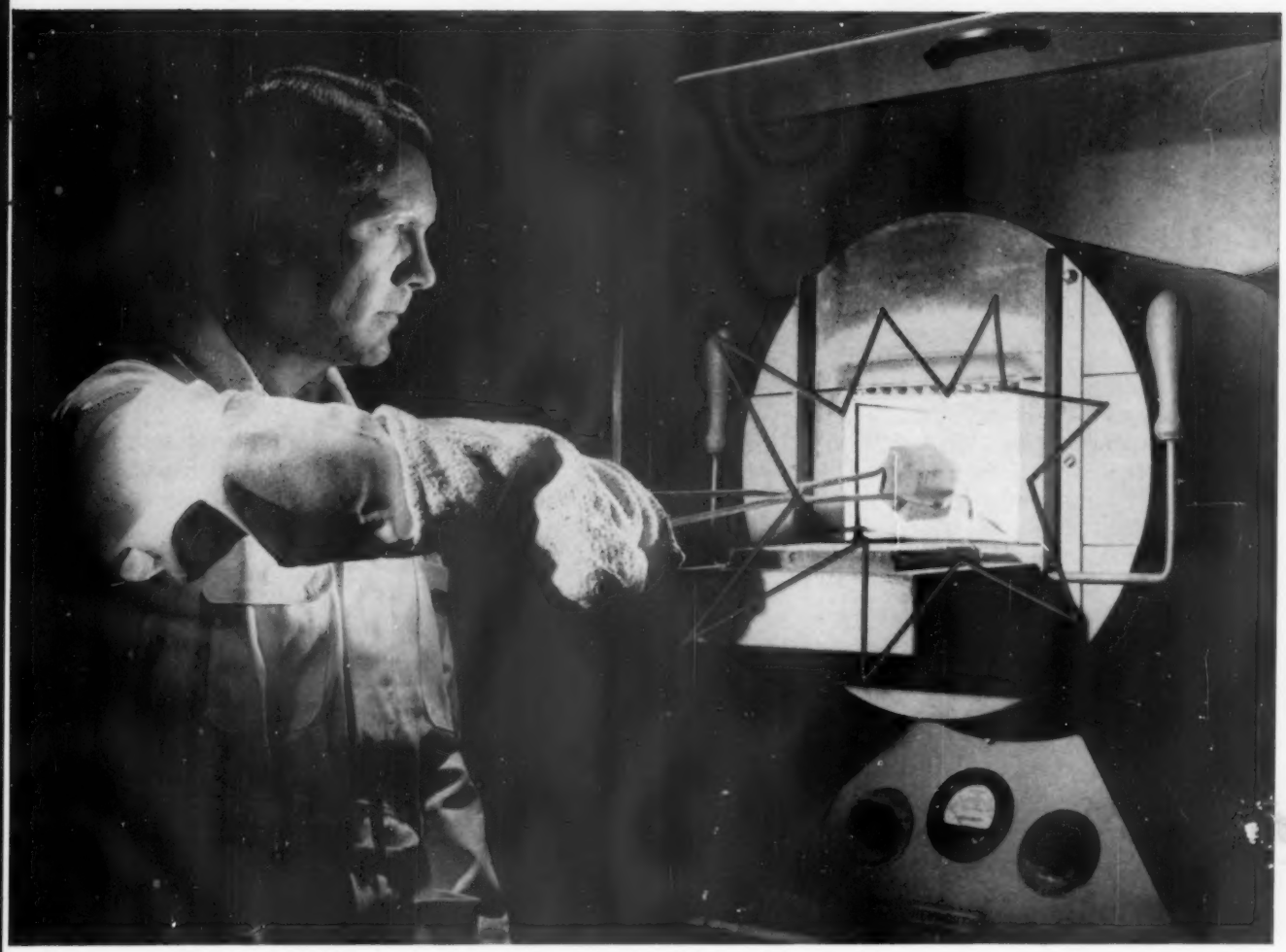

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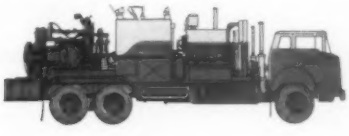

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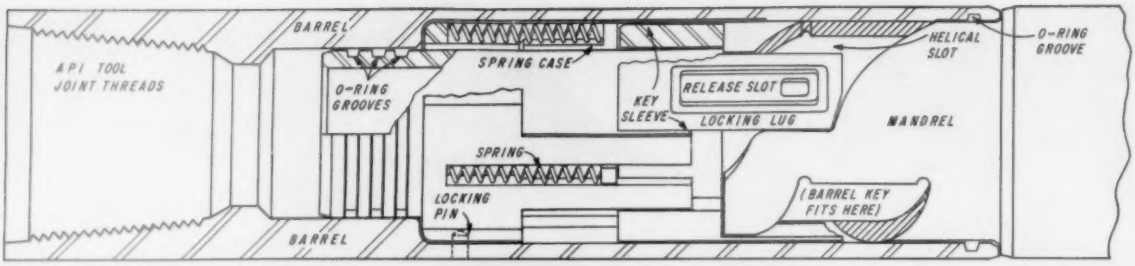

FIG. 5. Identification of some of the inner parts of the made-up joint show relationship of the locking lugs on the key sleeve when the mandrel is in the locked position inside the barrel.

leum Co. in West Texas. This particular joint was for 5-in. drill pipe. On the first well, the depth was 4330 ft when the joint was added to the drill string between the kelly and the first joint of drill pipe. Hole size was 9⅞ in. in diam and there were twenty-five 8-in. OD drill collars on bottom of the string.

The joint was successively moved down the drill string with each connection until a depth of 6386 ft was reached. At this depth, the joint was on top of the drill collars.

The joint was run on top of the drill collars to total depth of 9290 ft. It was dismantled, cleaned and inspected on each trip of the drill pipe. Altogether, it had been run for a total of 287 hr on this first well.

In a second well, the same joint was in the drill string a total of 31¾ hr while drilling from 3130 ft to 3991 ft. On this second well, the joint was used in the drill string while drilling a 12¾-in. hole with 5-in. OD drill pipe. Rotary speed averaged about 70 rpm, pump pressure was about 1000 psi and bit weight was approximately 80,000 lb. Based on the experience gained from these runs, some minor modifications have been made.

Special Offshore Job

One of the unusual and very successful applications of this threadless tool joint was carried out off the coast of California last winter by Western Offshore Drilling and Exploration Co. of Long Beach, Calif. A large mobile drilling unit was converted to a drilling platform which was located in the offshore waters. One of the engineering problems was that of providing anchorage for the 6-ft diam steel columns which supported the structure.

The ocean bottom at this particular location consisted of a shallow layer of silt on top of hard rock, making a conventional pile-driving operation impractical. Solution to this structure anchorage problem was to drill 36-in. diam holes through the supporting columns about 70 ft into the rock bottom. A large steel H-beam about 110 ft in length was lowered into the anchor holes and cemented solid its full length so the beam and cemented column extended some 40 ft up into the supporting columns of the structure.

A small run-around was welded atop each 6-ft column some 30 ft above deck to provide working space for the crews. An hydraulic-powered rotary table was used and it was mounted on top of and supported by the 6-ft column. A large crane on the structure did all the hoisting chores. A conventional swivel and kelly was used and sea water served as the drilling fluid.

So far so good. But, what about tonging up the drill pipe joints during the drilling operation?

The Shaffer threadless drill pipe tool joint was the answer. It required no tonging for make or break and could also serve as a convenient lift sub, since no provision was made for the conventional derrickman operation. Each joint was ratholed along side the small run-around atop the 6-ft supporting column. The entire operation was successful.

What the Future Holds

The evolution of one tool for another service is not a simple nor speedy program. There are critical design problems which can only be approached carefully and after critical study of weaknesses as revealed in actual use. Much has been learned already through a variety of limited field applications, including the two summarized here. Those at Shaffer Tool Works responsible for the past development of the threadless tool joint emphasize that much more must be learned and more designs tried and adequately field tested before any definite conclusions can be reached on the commercial use of this tool in routine drilling operations.

Acknowledgement

To the management of Shaffer Tool Works, the author is grateful for permission to gather the information presented above in the form of a progress report. Thanks go also to those who provided data and some of the illustrations.

J. E. Kastrop is editor of PETROLEUM ENGINEER, Dallas, Texas.

■

DRILLING CONTROL

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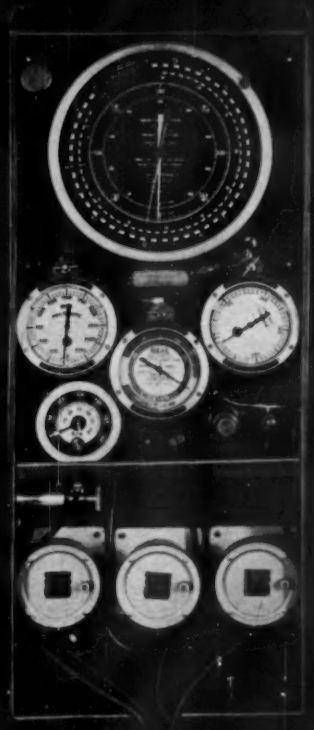

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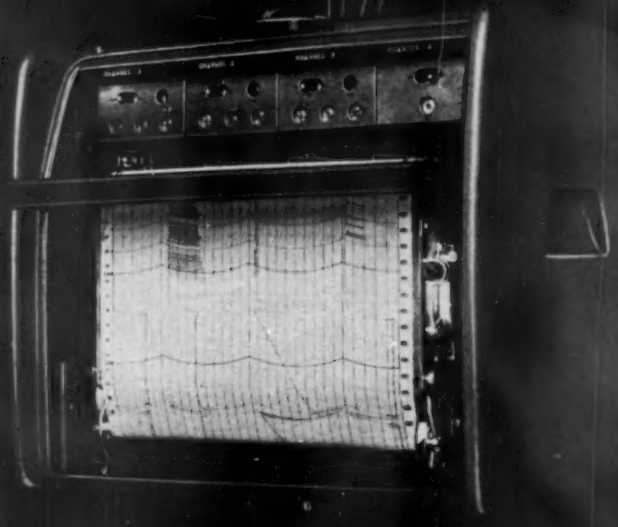

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A Look at Rocket Flame Drilling

What will oil and gas well drilling be like in the future? No one can say with any serious conviction because a number of revolutionary ideas already have been given serious investigation. Concentration of research in the past decade primarily has been on the downhole process.

Recognizing that not every idea or process will revolutionize our drilling methods, the editors of PETROLEUM ENGINEER believe it their responsibility to present to the petroleum industry any new information that has a bearing on drilling techniques. We have searched out other industries which also have the problem of making a hole in the earth . . . for this is basically what oil well drilling is about. It is interesting to note that the amount of total footage drilled each year in the U. S. petroleum industry is relatively small when compared to the total hole footage drilled in the mining and other industries. What are some recent technological advances in making hole in this industry?

Our search led us to the Linde Co., Div. of Union Carbide Corp., New York, which in 1947 pioneered the first industrial application of the rocket principle through introduction of its jet piercing process to "excavate" a blasthole in extremely hard rock. It has been applied to taconite, an iron-bearing rock not commercial as iron ore in its natural state and which cannot be made merchantable by simple beneficiation methods. Taconite is several times harder than any rock penetrated in our industry. It will scratch glass, and from an economic consideration precludes drilling blastholes by conventional methods. The jet piercing process explained here has been used principally to make blastholes to depths of 40 to 200 ft.

A recent report "Technical Advances Expand Use of Jet Piercing Process in Taconite Industry" by J. J. Calaman and H. C. Rolseth of Linde Co. details research and developments on this unique method of piercing a hole in the earth. By permission of Linde Co. and the authors, we have extracted only the highlights of this interesting report, taking into account only those topics of interest to our readers. In making this abstraction, we do not in any way suggest that this unusual process offers a new way to drill oil and gas wells. It may have potential applications, to be sure. We believe you will find it as interesting as we did.

What the Process Is All About

The jet piercing process is based upon a characteristic of the rock known as "spallability." Simply put, "spalling" is cracking under heat due to the differential expansion of rock crystals from thermally induced stresses. Extensive research has indicated no single property accounts for the "degree of spallability" of a particular rock. It seems to result from various physical, mechanical and thermal characteristics acting simultaneously.

Actually, this process is brought about by directing or blasting the rock with a high-velocity jet flame. This high heat intensity flame is generated by forcing oxygen and No. 2 fuel oil through nozzles in a downhole burner assembly. This burner (see Fig. 1) is not too much unlike a jet-type drilling bit minus the cutting surfaces. Energy for piercing comes from combustion of the process fluids. Expansion of gases in the combustion process and a water spray force the "spalled" or fragmented rock particles up the hole.

The jet piercing blowpipe, or drill assembly, is shown in Fig. 1. Three major components are the swing joint, kelly and burner assembly. Oxygen, fuel and cooling water are introduced into the rotating blowpipe through the swing joint (comparable to the swivel in oilwell rotary

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Jet piercing machine on location showing debris exhaust over top of housing.

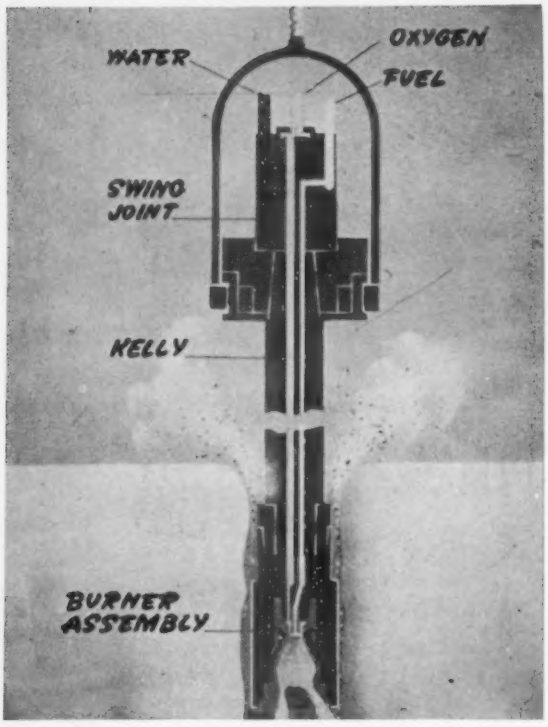

FIG. 1. Schematic of drill column showing kelly, swivel and burner assembly.

drilling). The round triple-fluted kelly is standard oilwell drilling equipment.

Oxygen and fuel are carried through separate tubes on the inside bore of the kelly to the burner assembly. The cooling water is brought to the burner in the remaining annular space inside the kelly and acts as a coolant. It is sprayed through nozzles at the bottom of the assembly.

The burner assembly consists of four main parts — the header, fuel injector, burner and reamer shell. The header is bolted permanently to the bottom of the kelly onto which the fuel injector and burner are screwed.

Liquid hydrocarbon fuel is atomized by kinetic impact of gaseous oxygen as it enters the rear end of a pear-shaped 15 cu in. volume combustion chamber. Burned gases are exhausted through divergent nozzles to produce intense flame jets. Reamer shell functions as hole sizer, protective casing and water jacket for burner.

The rocket flame jets produced from this blowpipe when operating at standard flows of 10,000 cfh of oxygen and 40 gph of fuel oil have an energy equivalent of over 500 mechanical horsepower based on a diesel efficiency.

Table 1 shows the approximate combustion intensity of various commonly known reactors.

TABLE 1. Approximate Combustion Intensity.

Reactor	Combustion intensity Btu/hr/ft ^{3}/atm
Bunsen flame	1.3×10^6
Four-stroke aircraft engine	4.0×10^6
German V-2 rocket	11.0×10^6
Linde jet piercing burner	75.0×10^6
High energy fuel rocket (Est.)	100.0×10^6

Burner Design

The heart of the piercing process lies in the burner, and most of the research and development has centered around this. Fig. 2 of a typical burner identifies the important design parameters and characteristics which can be varied in test work.

Continual experimental burner tests have been conducted by Linde to improve performance in semi-spallable rocks without sacrificing efficiency in good spalling zones. Test results thus far have been with 6½-in. burners . . . or bits . . . rated at 10,000, 12,000, and 15,000 cfh of oxygen. Average penetration speed for the 12,000 cfh burner in the extremely hard ore zones tested showed a 12 to 27% increase over

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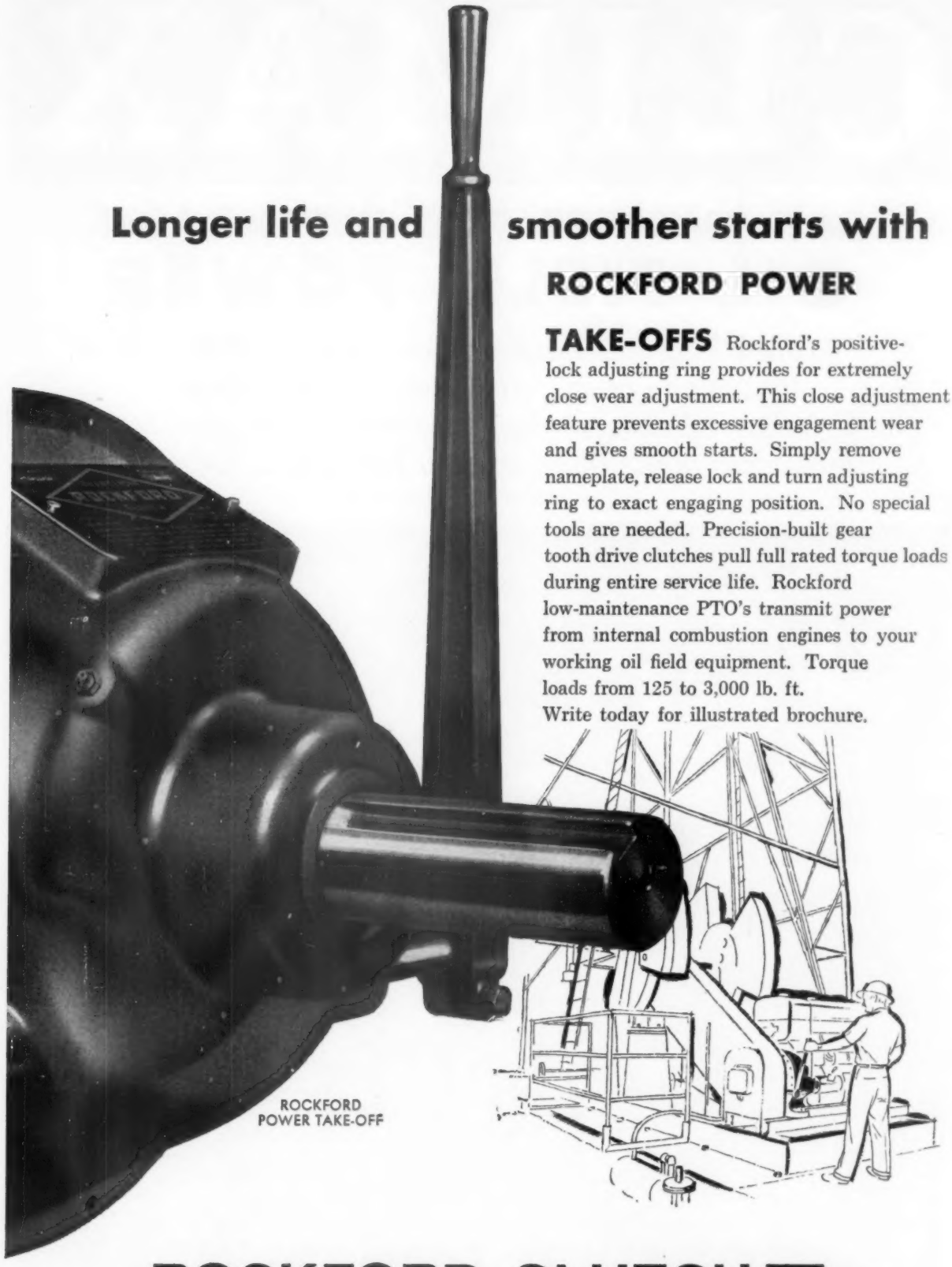

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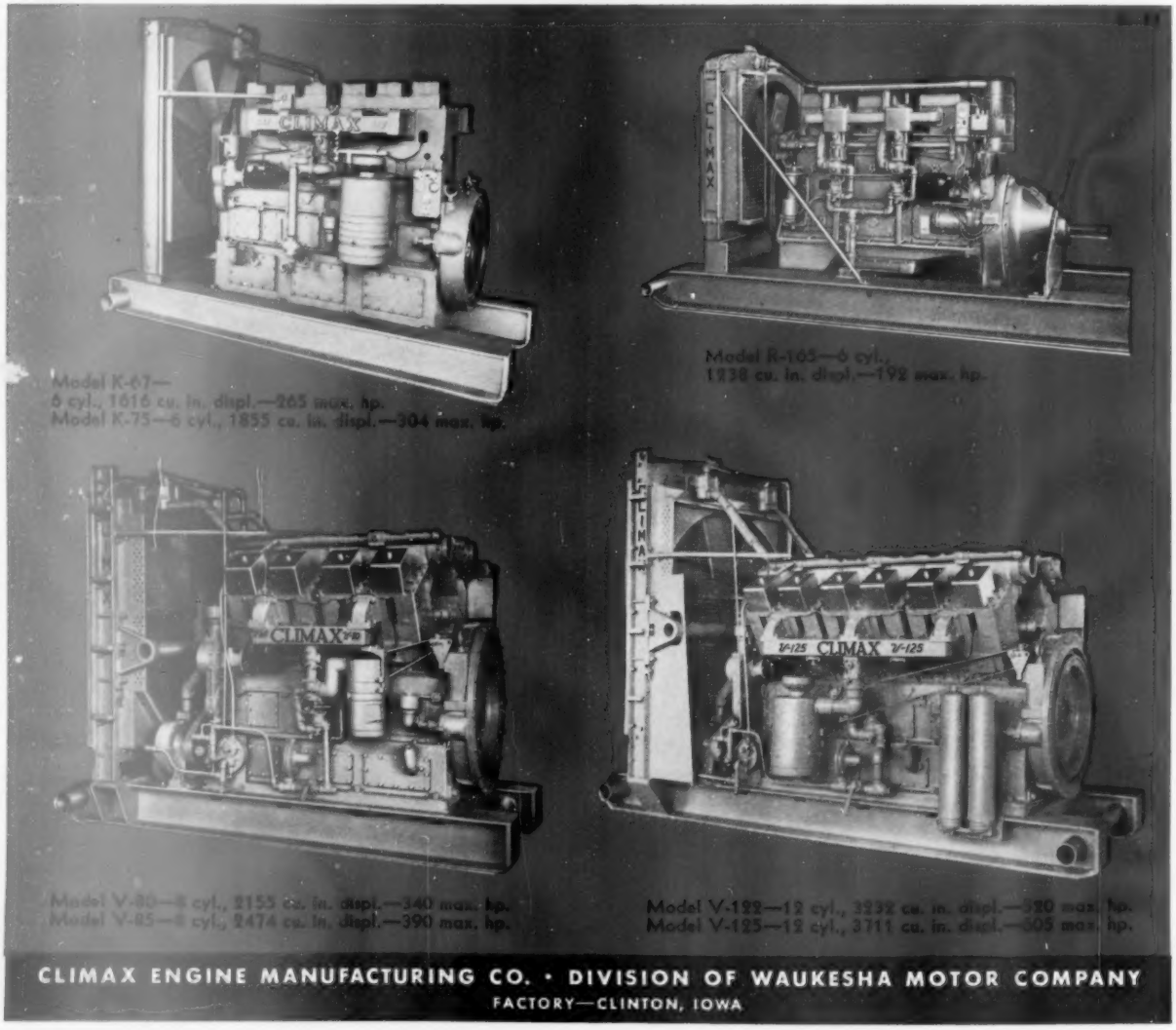
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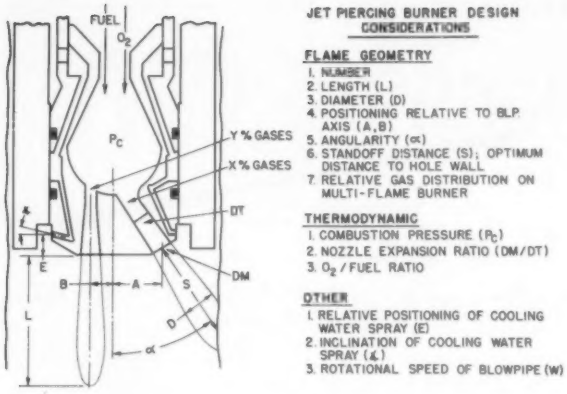

FIG. 2. Typical rocket flame burner. Identified are important design characteristics and parameters that can be varied in actual test work.

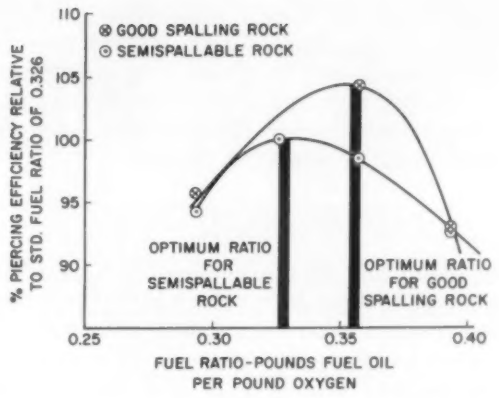

FIG. 3. Jet piercing efficiency in taconite as related to fuel ratio.

the 10,000 cfh burner. Noise is at a high level during the first few feet of drilling, but the hole does an effective job of muffling. Once this point is reached, this process is the quietest of all drilling methods.

Fig. 3 shows "drilling" efficiency as related to fuel ratio. Thermodynamics of rocket combustion indicate that optimum flame temperature and jet velocity are obtained at fuel-rich mixtures of reactants. (Note Table 1.)

Stoichiometric ratio of fuel oil and oxygen combustion is about 0.281 lb of fuel oil per lb of oxygen. Note on the curve that 0.326 is desirable in semi-spallable rocks and a still richer mixture of 0.355 is indicated for good spalling rock. Apparently, bushier flame jets obtained at a rich mix accelerate rock removal in good spalling zones.

Penetration Speeds

Of considerable interest to the oil and gas industry will be the penetration rates obtained in various rock and iron ore formations presented in Table 2.

Linde's field experience has aided in development of data on effect of flame drilling on various type formations, different rock characteristics and various formation conditions. They conclude that in rocket flame piercing, penetration speeds improve with depth as rock becomes more solid, less weathered and less oxidized.

They further determined principal thermal, physical and mechanical properties of rock which affect spallability. Although higher penetration rates result with high spalling tendency, the Linde engineers believe that at a certain temperature the rock becomes so elastic or plastic that spalling becomes impossible. Rocks with properties favorable to high degree of spallability are those possessing:

- Large linear thermal expansion at temperatures below 700 C.
- High thermal diffusivity at temperatures below 400 C.
- Equigranular interlocking structure with little or no fine-grained clay.
- No significant amount of elastic minerals.

Walls of a rocket-flame pierced hole are somewhat irregular and diameter tends to vary with spallability of strata.

The general trend is to reduce hole diameter as pierceability increases. Numerous tests show an actual hole volume twice that indicated by nominal burner size.

Fig. 4 shows average hole diameter as a function of penetration speed. It is significant to note that since there is no limitation on bit efficiencies, the smaller diameter burner or "bit" drills faster.

For hole enlargements, reaming, etc., there appears to be an optimum rate of heat input into the rock for maximum rock removal rate. Tests indicate the economics of large blasthole chambers (or reamed portions) are very attractive.

TABLE 2.

Rock or iron formation	Rocket flame jet piercing speed, fph
Oxidized and altered taconite	14
Lower cherty magnetic taconite, Area A	25
Lower cherty magnetic taconite, Area B	12
Upper cherty magnetic taconite, Area C	23
Lower slaty taconite	11-12
Michigan quartzite	30
Michigan jasper (magnetite specularite)	19-40
Labrador specularite	23-40
Michigan conglomerate	20
Michigan diorite	12
Michigan sericitic dike	9
Michigan argillaceous iron formation	14
Arkansas syenite	18
Massachusetts granite	20
Potsdam sandstone (St. Lawrence Seaway)	20

Rocket piercing differs from other methods because process fluids which include gaseous oxygen, fuel oil and water must be supplied to the machine. Safe and efficient procedures and equipment have been devised for accomplishing uninterrupted process fluid supply.

Oxygen Supply Data

Practical and proven equipment is available for any size operation. During the past ten years important advances have been made in storage, handling and delivery of oxygen to flame piercing machines. In 1949, the first installation for piercing was supplied with gaseous oxygen from a permanent high pressure 132,000 cu ft storage unit via a 1-in. steel and copper line operating at 600 psi. A pressure regulator at the end of the line reduced the pressure to 250 psi and delivered the gas through a 1-in. rubber hose 300 ft long to the piercing machine.

Recent improvements in burner design and distribution systems have made it possible to reduce operating pressure and maintain high burner efficiency.

One Michigan jasper operation now employs a 2½-in. steel pipeline operating at 160 psi. The pipeline is fed by a permanent liquid oxygen storage and gasification unit having a capacity equivalent to 310 000 cu ft of gas.

For large installations having three or more machines, Linde installed on-site gaseous oxygen producing plants. Gaseous oxygen from these plants is charged directly into 2400 psi semi-trailer gas transports of 75,000 cu ft capacity sufficient for one 8-hr shift.

In late 1960, a new portable liquid oxygen distribution system was placed in service on Minnesota's Mesabi range. The trailer weighing 14 tons loaded holds liquid oxygen equivalent of 150,000 cu ft of gaseous oxygen, capable of operating two full shifts. This unit can be filled in half an hour from a liquid oxygen storage tank. This trailer-mounted liquid oxygen storage tank is connected to a skid-mounted electrical vaporizer, which in turn delivers gaseous oxygen through 300 ft of 1½-in. oxygen hose operating at 150 psi.

Consumption of No. 2 fuel oil ranges from 240 to 285 gal per 8-hr shift. Fuel tank trucks can handle drilling-site refueling easily.

Standard water wagon hauling or pipelines to the drilling site are common. In cold climates, water must be stored in a 6000-gal insulated, electrically-heated, crawler-mounted water wagon equipped with a 1000-gpm pump driven by an oil motor.

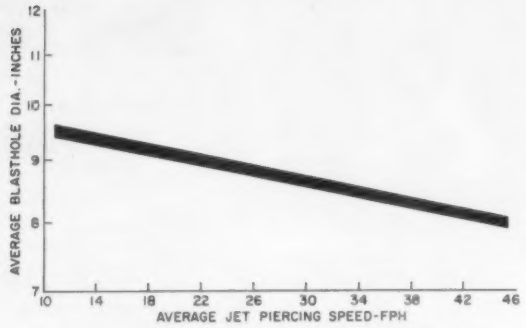

FIG. 4. Average blasthole diameter as related to jet piercing speed for model 6T36 burner at 10,000 cu ft per hr oxygen flow.

Drilling Performance

Development of techniques and advances in equipment have increased operating efficiency and productivity of piercing (drilling) machines markedly. Composite performance, Table 3 shows statistics from five operating properties in 1959.

TABLE 3.

Average production per scheduled 8-hr shift	96.5 ft
Burning time factor per shift	73.5%
Average piercing speed	18.2 ft per hr
Average penetration, including reaming	16.35 ft per hr
Maximum production record for 8-hr shift	276 ft
Maximum penetration rate for one blasthole	47 ft per hr

One measure of efficiency of the machine is the burning time factor as a percent of the total time. Over a three-year period annual improvements increased the efficiency with minimum downtime from 69.8% to 76.5%. This means burning time averaged 6.12 hr for every scheduled 8-hr machine shift. It must be remembered however that round-trip times and connection times common to the oil industry are not considered significant in this case because of the relatively shallow holes being used in blasthole application.

It has been estimated that for every 100 hr of burning time, repair time amounts to only 2.12 hr for a machine availability of 95% — an extremely high figure by oilfield standards.

Other Flame Processes

The rocket flame concept is also used in other forms for various industrial applications. As in the oil and gas industry, there is a cable tool version or suspension piercing process. Here, a simpler and less expensive machine can be used with single axial flame. As in the oil industry, this application is not as effective as rotary techniques—particularly in penetrating cracks, seams or melty areas. Its use is limited to more spallable materials such as granite, sandstone and quartsite.

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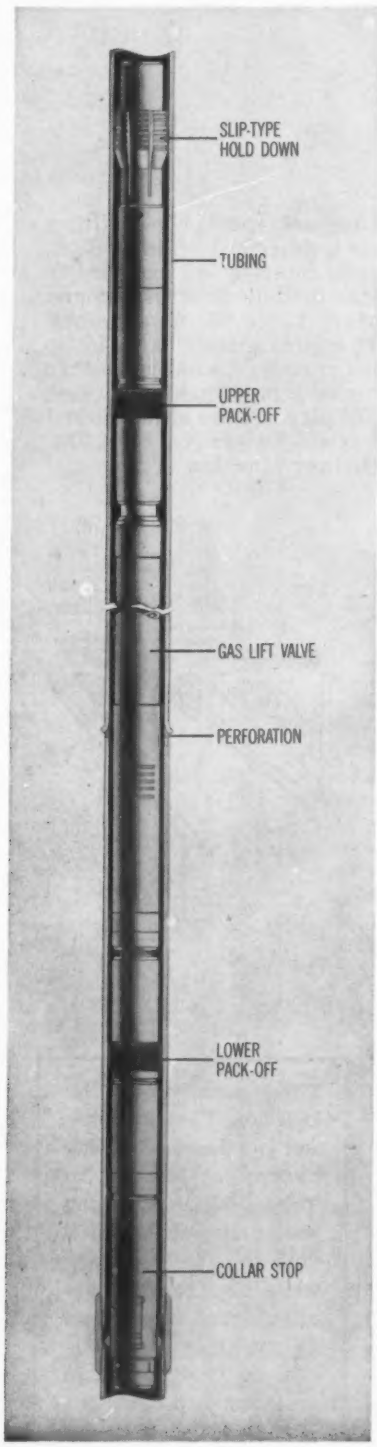
OTIS PRODUCTION NEWS

Volume II, Number 3 **Otis Engineering Corporation • Dallas** *Production Equipment and Services*



Cost-Conscious Producing Companies Endorse Otis All Wire Line Technique Of Converting Wells to Gas Lift

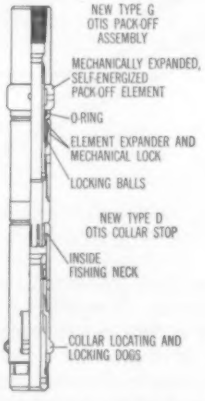
CORPUS CHRISTI—Eliminate the cost of a pulling unit to round-trip tubing when converting a well to gas lift and you can save an impressive amount of money per well. That's what several of the major producing companies in this area discovered when they started using the new Otis "All-Wire-Line" Gas Lift Conversion Technique.

A spokesman for one of these majors recently stated that his company is most enthusiastic about the technique — especially for water locations — because "(1) it's faster, (2) it's less expensive, (3) it's every bit as efficient as other types of installations they have made, and (4) it eliminates the risk of damage to the producing formation from contamination by mud and/or water in the annulus." Another company reported a savings of $60,000 in converting three, readily accessible, land locations.

As an example of how the technique can reduce the cost of a conversion, take a look at the following case history: A 6800-foot well located in approximately three feet of water in the Copano Bay Field ceased to flow naturally and was scheduled to be put on gas lift. In making plans to have the work done, it was discovered the approach canal had filled with silt and sand, which meant an expensive dredging operation would be necessary before a barge-mounted workover unit could be moved onto location; cost of a workover unit would be $1400 per day, and the annulus was loaded with old drilling fluid. Estimated conversion costs were mounting fast. A conference with the Otis Gas Lift Specialist in the area convinced the operator he should try a Type CG Otis Pack-Off Gas Lift Valve installation.

After setting a circulating plug in the tubing at the spot indicated for the lower-most valve, perforating and circulating mud from the annulus, it took the trained Otis Wire Line Specialist only 15½ hours of wire line time to perforate and install five concentric Type C Gas Lift Valves between Type G Otis Pack-Off Assemblies and have the well ready to be put back on production. Eight months following the conversion, the well was still making its allowable in an economical and efficient manner. And to attest to the reliability of the new Type G Otis Pack-Off Assemblies, the well was being produced from the lower-most valve.

Otis Gas Lift and Completion Specialists are interested in helping you find a way to complete and produce your wells in the most efficient manner. The experience these men have accrued throughout the years is yours to draw from when faced with any down well completion or production flow control problem. Use the knowledge these men have to offer and you will find you'll be spending your production dollars more efficiently. For more information on the Type CG Otis Pack-Off Gas Lift Valve, call the Otis office nearest you or write Otis, Dept. 3-W, Box 35206, Dallas 35, Texas. You'll find your Otis specialists ready to help you — anxious to serve you.


NEW TYPE G OTIS PACK-OFF ASSEMBLY
MECHANICALLY EXPANDED, SELF-ENERGIZED PACK-OFF ELEMENT
O-RING
ELEMENT EXPANDER AND MECHANICAL LOCK
LOCKING BALLS
NEW TYPE D OTIS COLLAR STOP
INSIDE FISHING NECK
COLLAR LOCATING AND LOCKING DOGS

Straight through, full opening bore of pack-offs, collar stop, and gas lift valve permits maximum production with minimum turbulence.

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OTIS

Engineering OTIS Corporation

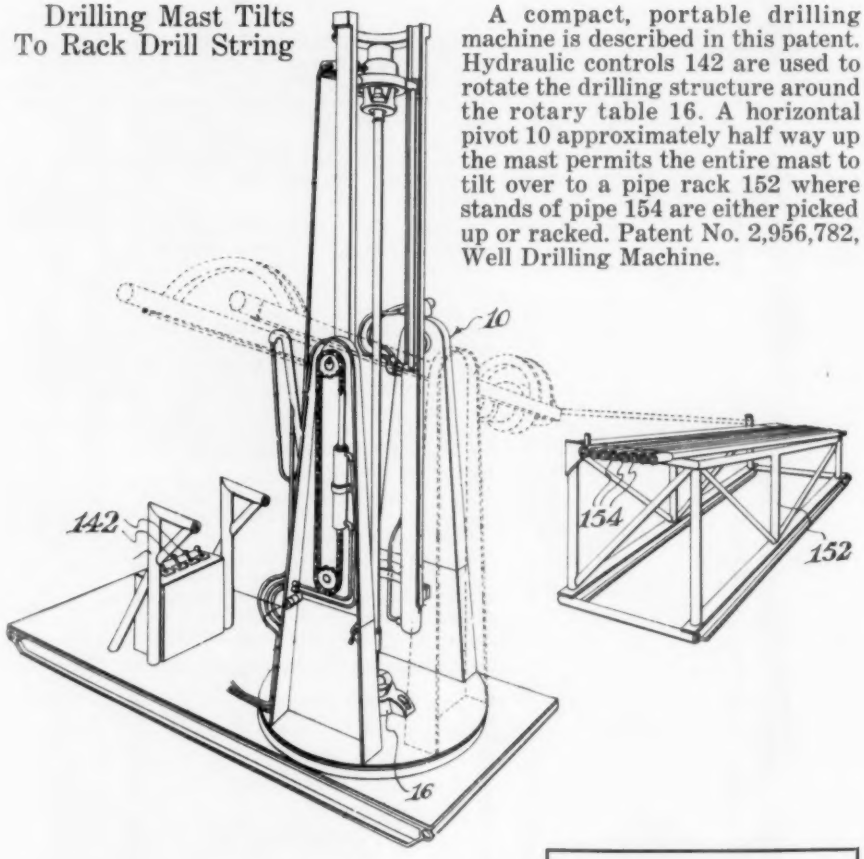
General Offices:

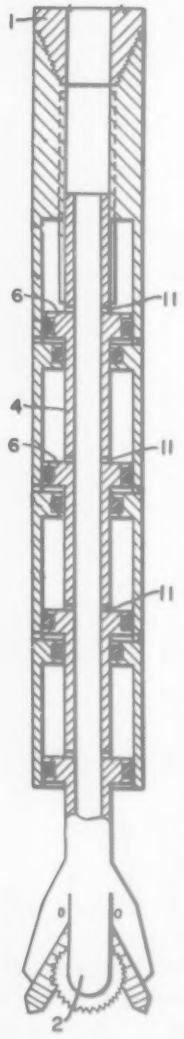
6612 Denton Drive • Dallas, Texas

What's New in Patents

Drilling Mast Tilts To Rack Drill String

A compact, portable drilling machine is described in this patent. Hydraulic controls 142 are used to rotate the drilling structure around the rotary table 16. A horizontal pivot 10 approximately half way up the mast permits the entire mast to tilt over to a pipe rack 152 where stands of pipe 154 are either picked up or racked. Patent No. 2,956,782, Well Drilling Machine.



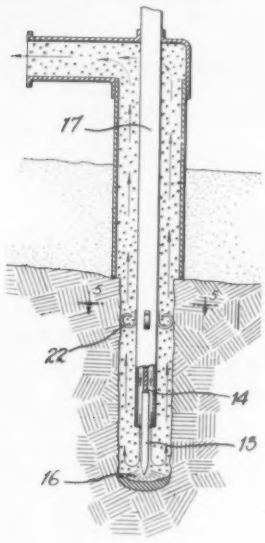


Drilling Sub Loads Bit Hydraulically

This device uses drilling fluid pressure to control the effective weight on the bit. The bit 2 is affixed to a telescoping member 4 which is prevented from rotating relative to the drill string 1 by a slot arrangement. Drill fluid passes through openings 11 above pistons 6 so that a downward hydraulic pressure is exerted collectively to the bit. This hydraulic force maintains a constant weight on the bit regardless of the relative positions of the bit and drill string. Patent No. 2,937,007, Well Drilling System.

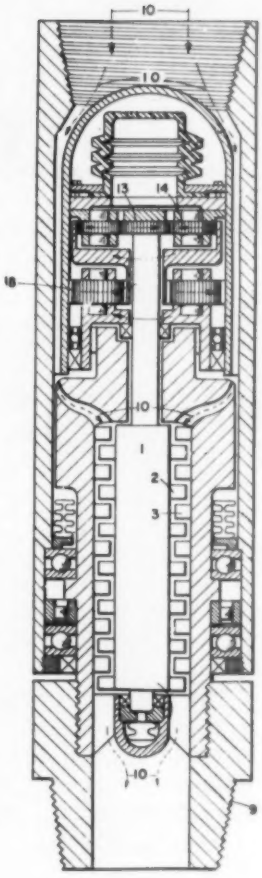
These patents were selected by Paul H. Johnson and James R. Head, patent attorneys in Tulsa, Oklahoma. If you want a copy of these patents for further study, write the Commissioner of Patents, United States Patent Office, Washington, D. C. Price is 25 cents for each copy.

Electric Arc Proposed For Drilling Wells



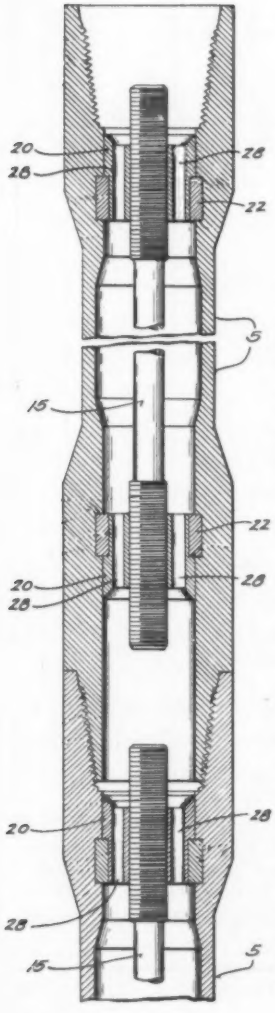
This patent covers a proposed method of drilling with an electric arc and claims that the rock is literally melted and disintegrated away. An electrode 13 is suspended from a conductor cable 14 through a tubular conduit 17. Centralizers are located within the conduit between the electrode and cables and, similarly, annular centralizers 22 are provided to keep the cable and conduit centered in the hole. Air or gas is directed through the tubular conduit and sweeps upward from the bottom of the hole 16 into the annular space and outward carrying entrained, molten or disintegrated rock. Patent No. 2,953,353, Apparatus for Drilling Holes in Earth.

High Speed Turbodrill Has Reduction Gearing

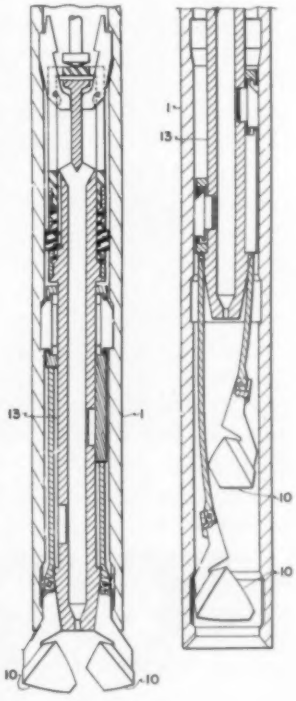


The turbodrill has been proved to operate most efficiently at relatively high speeds. This invention incorporates a gear-reducing transmission system which permits the turbine to operate at speeds from 5000 to 10,000 rpm while driving the bit at speeds up to 500 rpm to substantially extend bit life. Drilling fluid 10 flows through the tool past the turbine blades 2, 3 turning the rotor 1. Rotor energy is transmitted through a planetary gear system 13, 14, 18 to the lower end of the turbine unit 9 which is threaded to receive the drill collars and bit. Patent No. 2,937,008, High-Speed Turbodrill with Reduction Gearing.

Retractable Drill Bit To Eliminate Round Trips



Round trip time, one of the most costly drilling operations, could be virtually eliminated with perfection of this retractable drill bit. Drill cones 10 retract within the drive sub 1 when the bit is lowered into or removed from the hole. To position the cones for drilling, mandrel 13 is lowered, moving the cones sequentially into position. To retract the cones, a spear is lowered into the string to disengage the locking lugs. The entire bit assembly can then be removed from the drill string. Patent No. 2,982,366, Retractable Drill Bit.



Prestressed Drill Stem Permits Longer Strings

Wells are being drilled to such depths that the weight of the drill string in some instances can exceed the tensile strength of the material of which the stem is made. This invention helps overcome that problem by using prestressed sections of drill pipe. The drill stem 5 is provided with an internal anchorage 20 adjacent to the coupling ends. A rod 15 is fixed between and held by the anchorages. A nut 22 is used to prestress the rod under tension, placing that portion of the drill stem between the couplings under compression. The anchorages include by-pass openings 28 for the normal flow of drilling fluids. Patent No. 2,959,193, Prestressed Drill Stem.

First Quadruple in North Louisiana

The first quadruple well completion in North Louisiana was made recently by Marion Oil Co. and Del Cryer in the Ada field of Webster County.

The four-zone gas and gas-distillate producer is the No. 1 Archie Davis well with a total depth of 6646 ft. The bottom three zones were isolated by packers set in 7-in. OD casing cemented at 6644 ft.

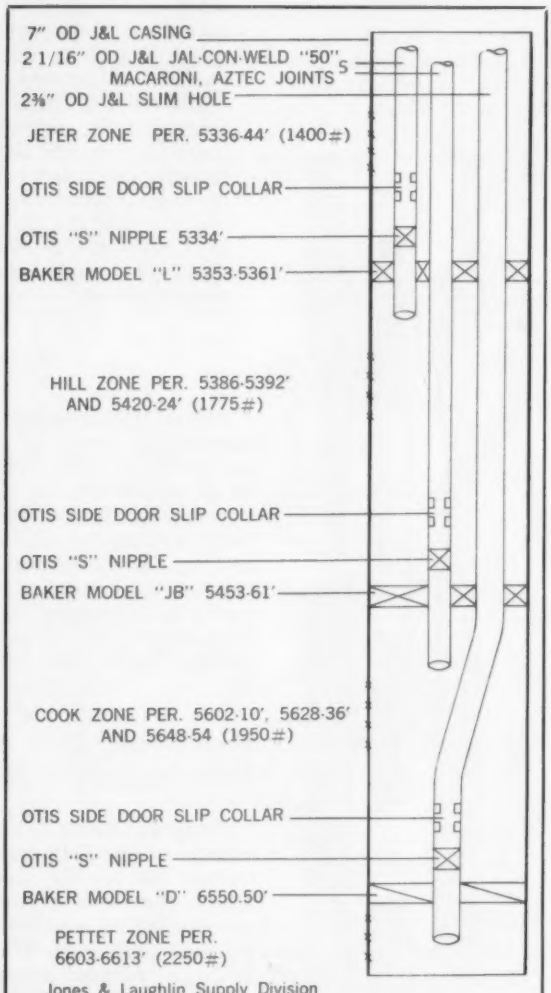
Production is through the casing annulus and three tubing strings consisting of one 2⅜-in. slim hole string and two 2 1/16-in. macaroni tubing strings. Basic elements of the completion are illustrated in the schematic diagram.

Upper horizon is the Jeter zone perforated at 5336-5344 ft which was completed through the annulus for a flow of 1,621,000 cu ft of gas and 2.98 bbl of 61.1-gravity distillate daily on a ¼-in. choke. Tubing pressure was 1400 psi.

The Hill zone was perforated at 5386-5392 ft and 5420-5424 ft. It produces one of the 2 1/16-in. OD macaroni tubing strings. Daily flow rate on a ¼-in. choke is 1,750,000 cu ft of gas and 9.03 bbl of 63.6-gravity distillate. Tubing pressure was 1775 psi.

Next to the bottom zone is the Cook formation perforated at 5602-5610 ft and from 5648-5654 ft. Its daily flow is 1,096,000 cu ft of gas and 5.56 bbl of 64.6-gravity distillate per day through the second 2 1/16-in. OD macaroni tubing string on an 11/64-in. choke. Tubing pressure measured 1950 psi.

Lower zone is the Pettet which produces through the 2⅜-in. OD slim hole tubing from perforations at 6603-6613 ft. Production is 2,662,000 cu ft of gas and 8.04 bbl of 61.3-gravity distillate daily through a ¼-in. choke. Tubing pressure was 2250 psi. ■


7" OD J&L CASING
2 1/16" OD J&L JAL-CON-WELD "50" MACARONI, AZTEC JOINTS
2⅜" OD J&L SLIM HOLE
JETER ZONE PER. 5336-44' (1400#)
OTIS SIDE DOOR SLIP COLLAR
OTIS "S" NIPPLE 5334'
BAKER MODEL "L" 5353-5361'
HILL ZONE PER. 5386-5392' AND 5420-24' (1775#)
OTIS SIDE DOOR SLIP COLLAR
OTIS "S" NIPPLE
BAKER MODEL "JB" 5453-61'
COOK ZONE PER. 5602-10', 5628-36' AND 5648-54 (1950#)
OTIS SIDE DOOR SLIP COLLAR
OTIS "S" NIPPLE
BAKER MODEL "D" 6550.50'
PETTET ZONE PER. 6603-6613' (2250#)
Jones & Laughlin Supply Division

North Louisiana's first quadruple well completion employs three tubing strings inside 7-in. OD casing with upper zone produced through the annulus.

O·C·T presents three new hangers for the C-22 Casing Head

The new O·C·T C-22 casing head accepts a family of three new heavy-duty, interchangeable hangers. This straight-bore casing head is designed to support maximum loads.

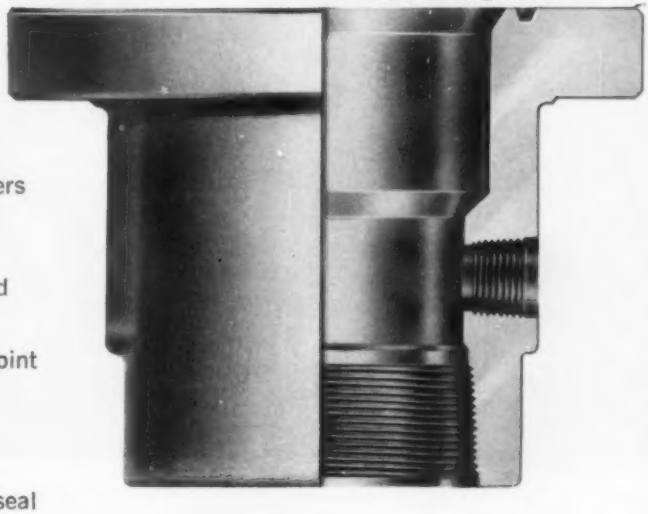
Hangers designed for the C-22 casing head include the C-21, C-21-W, and C-22. All three hangers are interchangeable with each other and with O·C·T's tubingless completion hangers. These hangers feature O·C·T's improved slips that hold extreme loads without crushing the casing.

Each hanger can support weight beyond the joint strength of the pipe iself, with minimum casing deflection. All three can be lowered through blowout preventers.

- **C-21 casing hanger:** slips, slip bowl, and floating seal ring that provides positive annulus packoff.
- **C-21-W casing hanger:** welded-to-casing version of the C-21.
- **C-22 casing hanger:** single-unit sealing element, slip bowl, and slips; automatic seal; spring-loaded latch.

See your nearby O·C·T representative for further information, or write to Oil Center Tool Company, P. O. Box 3091, Houston, Texas.

C-22 Casing Head



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This is just one example of the many continuing efforts by W-K-M engineers to go beyond "just the necessary" to bring you the best possible valves through highly creative approaches to difficult engineering and manufacturing problems. And who benefits from W-K-M's creativity in action? You do . . . of course.

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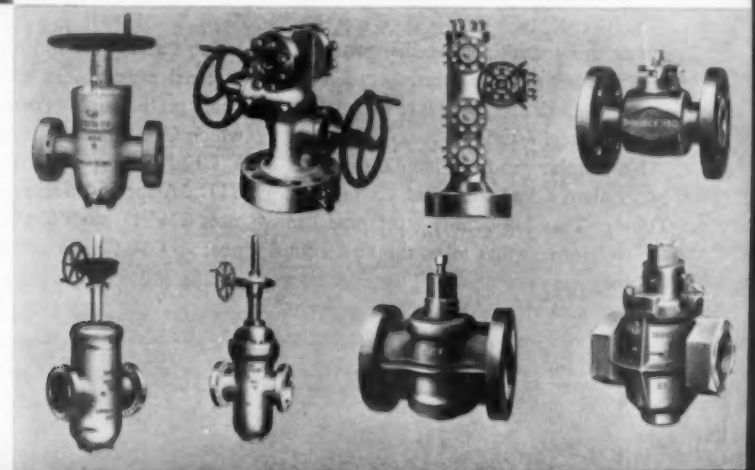

If crude came up in cans, casing and tubing wouldn't matter

But nature doesn't package her products. She requires you to wrench crude oil from the earth and carry it to the surface in tough steel arteries.

No tubular products handle this load better than CF&I Seamless Casing and Tubing. This top-quality steel pipe has the *straightness* that takes the kinks out of production problems . . . the *precision threads* and *strong joints* that prevent leakage and withstand high internal and external pressure. In addition, you can count on the quality *customer service* for which CF&I has long been noted.

CF&I Casing and Tubing meets API STD 5A specification and is available in sizes 2⅜" through 9⅝" O.D. Call your nearby CF&I sales office for complete details and speedy delivery. 8201

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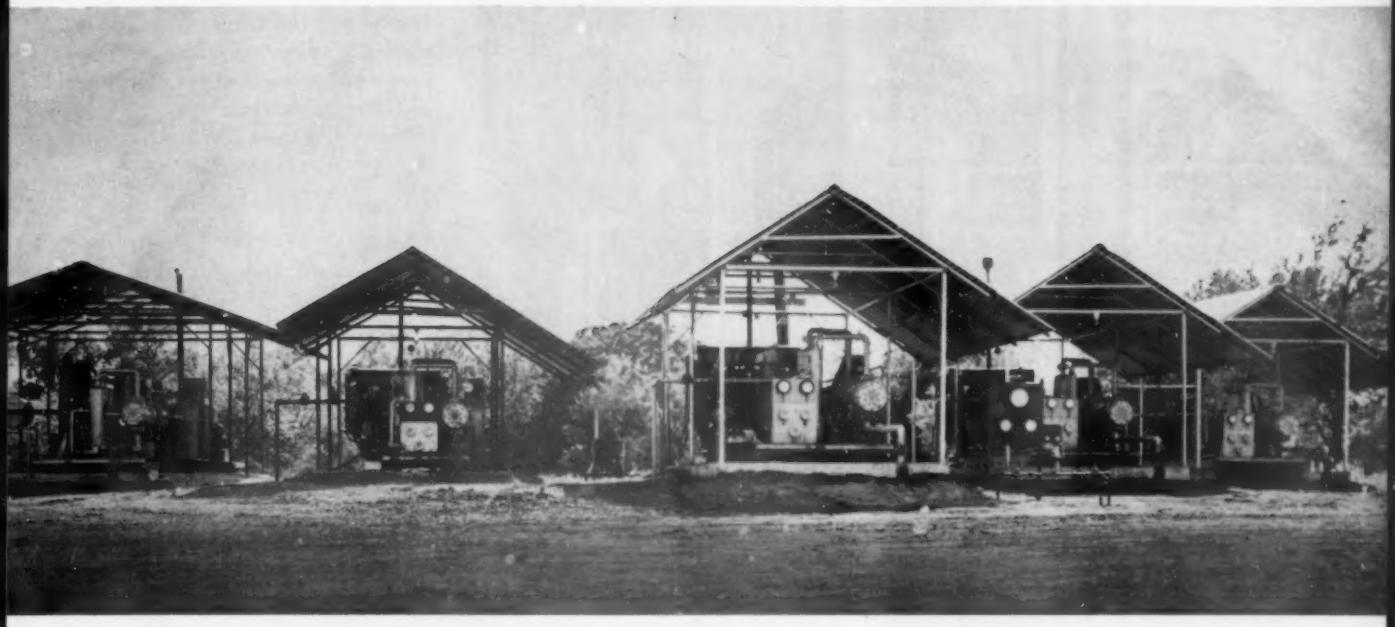

This battery of heavy duty compressor units supplied by Mid-Continent is helping to increase oil production for our Corsicana, Texas customer.

Whatever or wherever your secondary recovery equipment requirements, Mid-Continent can assist with trained personnel and a complete line of quality products to meet your exact needs. Following is a partial list of secondary recovery equipment available through Mid-Continent:

Injection Pumps	Controls, Safety
Engines	Meters & Regulators
Compressors	Filters, Graded Bed
Valves	Filters, Individual Well
Control Panels	Welding Fittings & Flanges
Pressure & Flow Recorders	Grooved Couplings & Fittings
Controls, Pneumatic	Gauges

SR1-1

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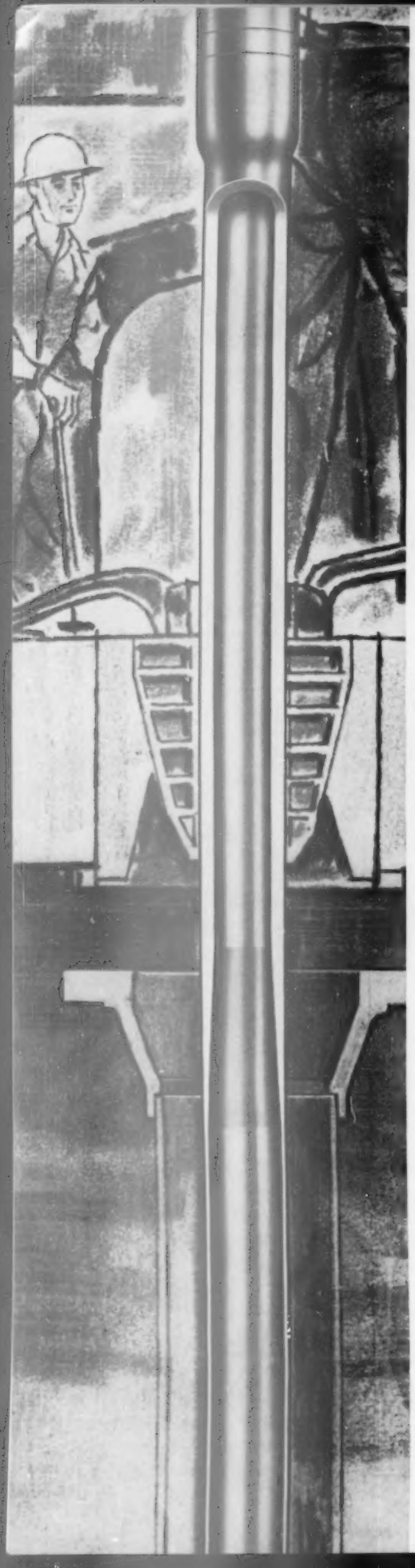
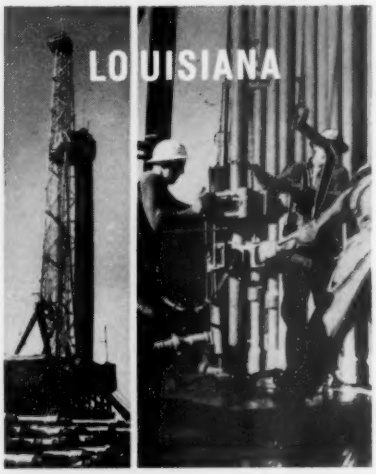


PITTSBURGH STEEL REPORTS ON...

DUAL WEIGHT DRILL PIPE

SUCCESS IN FIELD TEST



In West Texas, South Louisiana, Oklahoma and out on the West Coast, Pittsburgh Steel Company's new Dual Weight Drill Pipe is proving itself the way drillers best understand—by performance under actual field conditions.

Dual Weight is a completely new type of drill pipe developed and produced exclusively by the manufacturer of "Pittsburgh Seamless."

It provides drillers an integral combination of strength and light weight never before available in popular API grades and sizes of drill pipe.

Drilled footage on four strings of Dual Weight now stands at better than 100,000 feet—every inch of it under normal rotary drilling practices.

Results? Excellent—better than expected in some cases.

Field tests are continuing. Additional strings are being placed in service on drilling operations specifically selected to prove out Dual Weight's advantages and performance under the widest possible range of drilling conditions.

But, so far, here's what experience shows Dual Weight does:

- Cuts drill string weight.
- Increases rig depth capacity.
- Increases slip area strength up to 20 percent.
- Boosts hydraulic performance.
- Effects lower maintenance costs and longer service life on rig equipment.
- Cuts transportation costs.
- Increases drilling rates and speeds up round-trips.

• **What is Dual Weight?**—First of all, it's one of the most important developments in rotary drilling in many years. It's an entirely different type of drill pipe design—although it looks the same as other drill pipe. The difference is in the ID.

Look at the cutaway sketch at the left of this page. It shows Dual Weight's design features.

Notice the box end. Below the tool joint and upset, it has at least four feet (but not more than six feet) of heavy wall steel in the critical slip area. Then, a gradual, uniform internal taper makes transition to a light wall body that extends the remainder of the joint's length.

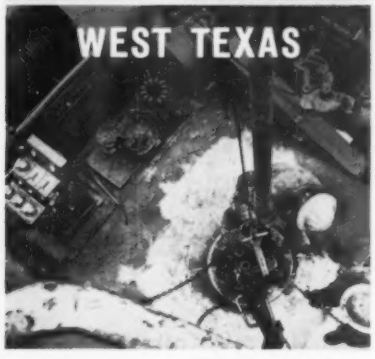
Some drillers refer to the heavy wall at the box end as a "long upset"—a good description, but inaccurate. The heavy wall is produced

by a patented process that bears no resemblance to upsetting.

Drillers can benefit two ways with Dual Weight.

If it's a lower hook load they want, then thin wall Dual Weight meets the need. It combines the strength of standard pipe in the slip area, and the weight saving of lighter weight pipe in the body.

Or, if extra strength and safety—rather than lower weight—are required, Dual Weight again is the answer. In this version, it has a standard wall body and an extra heavy box end with a safety factor

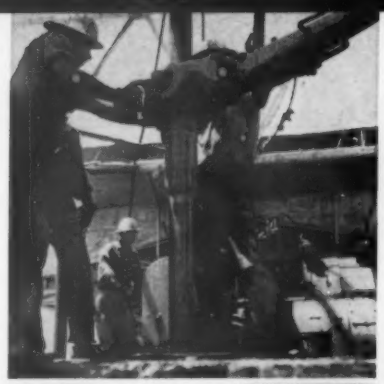


near or equal to the safety of the body.

• **Strength?**—Either way, Dual Weight has it—in the slip area where it's needed to resist the notching, crushing, crimping, stretching and bending forces it is subjected to.

Light weight? Its thinner wall body eliminates pounds per foot over 85 percent of the length of a 30-foot joint.

For example, 4½-inch Dual Weight with a .337/.254-inch wall weighs 16.60 lb./ft. for 15 percent of its length (the box end) and 13.25 lb./ft. for 85 percent of its length (the body).



And don't overlook hydraulic performance. The larger ID resulting from Dual Weight's thinner body wall lets pumps push more mud at lower pressures. There's more energy applied at the bit. Penetration rates are higher and returns are better.

But here's a sample of how drillers themselves benefit from Dual Weight.

A Large Independent Oil & Gas Drilling Corporation—drilling shallow wells in West Texas with 6,000 feet of 4-inch (.330/.254-inch wall) Grade E Dual Weight.

A Drilling Superintendent—"I believe Dual Weight is the only thing for a little rig. Its lighter weight means less wear and tear on the rig and equipment. And when you move as often as we do, there's quite a saving on trucking charges. Any time we can get away from handling weight, we're better off."

A Veteran Tool Pusher—"We save trip time because we can come out of the hole faster. With less weight we get more rpm's. We save fuel, too, because our engine isn't working as hard."

• A major oil company, drilling deep wells in Louisiana with 15,000 feet of 4½-inch, (.337/.271-inch wall) Grade E and P-95 Dual Weight.

A company drilling engineer said: "We're looking for higher velocities and larger volumes of fluid at equal pump pressures from Dual Weight. We know we're getting better hydraulics—moving more fluid.

"In deep drilling with high mud weights, you get better penetration with increased bit hydraulic horsepower. We calculate we're getting a 25 percent increase in BHP."

Interested in more detailed information? Write for literature, or contact a Pittsburgh Steel district sales office or one of the independent distributors listed below.

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QA QA QA QA QA QA

probably be back in. Many of the small ones continue in business today.

Q. What are your thoughts on the adequacy or inadequacy of drilling crews and personnel?

A. Without question, we've lost a great number of skilled and trained crews. These have gone into other industries because of long duration of idleness between jobs and because of the relatively low pay as compared with other industries. The matter of skilled crews, which can make or break a job, is going to become increasingly serious. Drilling contractors and operators need to be seriously concerned about the personnel problem. Of course, an increase in pay is the answer.

Q. How about training and fringe benefits for the crews?

A. The industry is increasing its training efforts. We can detect this through AAODC training programs and various drilling schools (we now have three). A larger number of contractor personnel are participating than before. AAODC has developed an intra-company training program within the last year and this has been booked almost continuously since it was completed.

Q. Have you any ideas or thoughts on the contractor-operator relationship?

A. There are a good many points or places in such relationships where proper operating techniques would reduce drilling costs. It is my feeling that conferences between the operating personnel of operators and contractors to discuss a particular job would be extremely beneficial. Each has seen what will work or what will not work successfully in his area. By pooling their experiences, I think there could be suggestions where cost reductions could be made.

Q. Should this conference precede or follow bidding?

A. It would almost have to be after the contract has been awarded so as to bring together those who are actually going to be performing the jobs. At this point, various changes in drilling plans could be developed and then used on future wells.

Q. Is there any contractor-operator relationship that you feel might help in pre-bidding practices to give the contractor a better picture of what he is bidding on?

A. That is extremely important, and in too many cases these days full specifications are not spelled out. Today we are drilling under formal contracts which need to be more fully developed and clarified on all phases as to who is responsible for each particular thing.

Q. What do you think about the turnkey contract as we understand it today?

A. Speaking for the full turnkey, where the contractor is responsible for everything until the well is turned into the tank, this seems to be increasing and there are many advantages for the small operator who is not fully staffed. This is undoubtedly going to continue to grow. I don't know that it is going to become so widespread among the major companies who desire to keep more control and who have the personnel to do so.

Q. What are the disadvantages to the contractor on turnkey operations?

A. He is taking enormous risks as compared with the usual footage contract, and he must be absolutely certain he has properly priced his bid to cover the risk if he gets into some difficulty.

Q. What does the picture look like now as far as the contractor is concerned on the new Federal Aviation Agency ruling about erecting structures 150 ft and higher?

A. The FFA counsel stated at a hearing before the Fifth Circuit Court of Appeals August 25 in New Orleans that the agency has no intention of enforcing these regulations against drilling rigs until the whole matter has been finally resolved. We should have a court ruling on our petition (API — AAODC petition) for a stay before this can appear in print.

Q. So now the contractor needs to keep his eyes and ears open as to the outcome of the ruling.

A. Yes. We still have not given up hope that we may get some administrative relief through FFA. The agency is continuing its study on this matter and expects to complete their study within 30 days.

"Just cutting price is not necessarily the way to get a job"

Herbert F. Beardmore, vice president, Domestic Production Operations, Gulf Oil Corp., Houston, Tex.

Q. Do you think our belt-tightening programs have reached a plateau?

A. Yes, as far as we are concerned. Gulf now has a decentralized organization with well trained, educated and energetic people in the key spots. Our field personnel have a substantial amount of authority and responsibility which, incidentally, makes a vigorous organization.

Q. What do you think is the long term outlook for petroleum? Do you think that by 1970 it will be stronger as an industry than it is today?

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A. That is the trend, and I don't see why there should be any reversal. With the population increasing, the need and uses for petroleum are going to increase.

Q. What is your feeling about searching for new oil reserves in light of high finding costs and no increase in price?

A. We must avoid areas that have been worked over extensively. We must try to apply new techniques to the potential areas and then use some imagination as to where we might find attractive areas. It will surprise you how many opportunities there still are.

Q. What effect, if any, do you think the recent Internal Revenue rulings or lack of rulings will have on future property acquisitions involving the ABC transaction?

A. The new ruling will be harmful to the small operators. It is less attractive to them to sell and therefore it will be less attractive to buy. It will result in less wildcat activity.

Q. How big do you think our over-all exploratory drilling program will be in years ahead?

A. Independents drill 75% of the wells. The factors that cause the independents to drill those wells will have a great effect on nation-wide exploration activity. The major companies probably will continue the same trend they have in the past. Wildcat wells are getting deeper on the average and for that reason majors spend more money on fewer wells.

Q. How does Gulf handle its domestic drilling operations?

A. We own and operate no drilling rigs. The area production manager lets our drilling contracts for wells which have been approved and budgeted. Our area drilling foreman supervises Gulf's drilling operations in the field (Gulf's areas are the last line of supervision). We have a technical service group which contains drilling specialists who are on call for any area at any time. There are also drilling engineers in the district offices.

Q. Do you have any counsel to offer the drilling contractor?

A. We are interested in progressive contractors who are willing to take jobs off our hands and pursue them with good engineering practices and initiative to get them done. To give the contractors opportunities to exploit their own abilities, some type of turnkey job is my preference. I would urge contractors to be truly contractors instead of merely renters of tools and services. We want a contractor who is willing to carry out completely the job we want done. We are willing to pay the competitive price for getting it done.

Q. Do you feel that the lowest bidder should always get the contract?

A. We give it to the lowest bidder who is competent. We intend to solicit bids from contractors who have adequate tools, manpower and finances. That is the way to prevent an unfair low bid.

Q. Do you think the contractor who is set up for turnkey contracts ought to include the financing as well?

A. Yes, I think so. We are trying to simplify our own bookkeeping. We would like to contract a job on a certain basis and, when it is finished, pay off. One time, one check and one evaluation. I read about contractors and their distressed condition. I get the feeling that they believe the company causes their distress over low prices and extreme competition. That isn't the producer's fault. I wouldn't know how to stop it if I tried. It is just one of the facts of the competitive way of American life.

Q. How can you protect a contractor from unusual risks?

A. There are a great number of ways. One example is the partial-turnkey contract. You don't have to have a full fledged turnkey contract; it can be a semi-turnkey contract. A producer can relieve himself of many items that need watching. The mud problem is one. If you know by the mud company's records and your own experience what a mud bill should be approximately, you can set that in the contract and the company will pay the contractor that amount of money. If it goes below that amount, he profits. If it goes above it, there are various ways of compensating, such as the company paying half of the overage. This procedure keeps the responsibility on the contractor.

Q. You still have the lost circulation clause, don't you?

A. In certain instances it has to be there, but I would like to eliminate or reduce its use. This clause transfers the load of a problem from the contractor back on the company, and when corrected transfers the operation back to the contractor again. We would like to keep the responsibility in one place.

Q. What is your thinking on slimhole, permanent type, tubingless and multiple completions? How do these affect drilling?

A. Multiples certainly do increase completion costs. In our present scheme of allowables, they are an economic necessity. Although the costs are high, the proportion of the cost as com-

Rugged joint of Extreme Line tubing permits repeated make-up and breaking out without galling. Operators like the fast make-up that results from the integral design.

Why operators prefer SPANG Extreme Line Tubing

Streamlined design of integral joint SPANG Extreme Line tubing eliminates the need for couplings. The high strength joint provides a metal-to-metal seal that resists leakage in the deepest, high pressure wells.

Extreme Line joints are streamlined internally and externally, minimizing possibility of hanging up or stripping under pressure. Integral joint eliminates 50% of the threaded connections in conventional designs.

Wide, heavy, modified Acme threads speed joint make-up with minimum chance of cross-threading.

SPANG Extreme Line tubing is readily available in grades J-55, N-80 and P-105. It rounds out National Supply's complete tubing line for every specific application. Call your National Supply representative for complete information, or write to National Supply Division, Armco Steel Corporation, Two Gateway Center, Pittsburgh 22, Pennsylvania.

See next pages for more information on Spang tubular products

Why SPANG Extreme Line Casing out-performs other casing in deep, high pressure wells

Unique metal-to-metal seal makes SPANG Extreme Line casing 100% leak resistant. Precision machined seals on box and pin ends of the casing bear up under the heaviest loads in tension and compression.

Integral joint eliminates couplings. The joint design provides greater strength with considerable reduction in diameter.

Cross threading is practically impossible. Any initial misalignment is automatically corrected by the broad, flat-crested threads which guide the pin quickly into positive engagement with the box.

Extreme Line casing can be re-run many times without galling. The sturdy, Acme-type threads afford higher recovery than API casing, without rethreading.

This advanced design reduces the number of threaded connections to one-half those required with T&C casing, as the coupling element is an integral part of the casing.

Extreme Line casing is available in Grades J-55, N-80 and P-110. Your National Supply representative will be happy to discuss the basic advantages of this casing with you. Or you can get complete details by writing to National Supply Division, Armco Steel Corporation, Two Gateway Center, Pittsburgh 22, Pennsylvania.

Extreme Line casing is just part of the National Supply complete line of oil country tubular products. Spang drill pipe and National drill collars were also used in this Louisiana well.

Why SPANG Drill Pipe and Tool Joints are the logical choice for your drilling program

SPANG drill pipe is specifically engineered to minimize leakage, fatigue, tension and corrosion. Operators have found they can depend on it for fast, dependable performance. There is also an advantage in the fact that National Supply is the only company that manufactures both drill pipe and tool joints.

Spangweld drill pipe and tool joints provide fast, dependable operation. The tool joints are welded to the drill pipe by an automatically controlled operation that insures accurate alignment and a high quality weld. Welding permits a streamlined contour and a reduced number of threaded elements. This tool joint connection also allows a small O.D. and maximum bore — a definite advantage for slim hole drilling.

Another field-proven SPANG drill pipe product is the Double Seal Shrink Thread tool joint. This joint is designed with two distinct seal areas — one internal and one external. The threads have no sealing function to perform. The two sealing surfaces and the shrink thread design result in a joint that is leakproof and minimizes possibility of washout. The tool joints can be removed and replaced easily in the field.

Both of these drill pipe products are available with SPANG Hardfacing, a superior protection for tool joints in abrasive formations. It consists of multiple bands of tungsten carbide, continuously over-lapped on the joint to form a solid particle-to-metal band.

SPANG drill pipe is readily available in every diameter and type now in use. Consult your National Supply representative for details, or write direct to National Supply Division, Armco Steel Corporation, Two Gateway Center, Pittsburgh 22, Pennsylvania.

Spang drill pipe is field-proven in the toughest oil country applications. It is available in a full range of sizes.

Steel

Steel's Symbol of strength, long life, and economy

This Spang CW pipe is used in gathering lines in this California operation. The pipe has wide application in gas, oil and water gathering lines.

MOST DEPENDABLE STANDARD PIPE IN THE WORLD... SPANG CW Pipe

Superiority of SPANG CW steel pipe is due to the strictest possible quality control in every manufacturing step. This quality control pays off in uniformity and dependability.

Every length of SPANG pipe is hydrostatically tested and inspected for thread quality. The uniformity of this pipe can save you many hours in laying gathering and feeding lines. And most important, there is no premium price for SPANG quality. All sizes, plain end or threaded and coupled, are available now.

Next time you buy pipe, call your National Supply store. You'll find the pipe is easy to cut, bend, thread and weld. For name of your closest source of supply, just write to National Supply Division, Armco Steel Corporation, Two Gateway Center, Pittsburgh 22, Pennsylvania.

ARMCO National Supply Division

DRILLING WITH **AIR?...GAS?...MUD?...REVERSE CIRCULATION?**

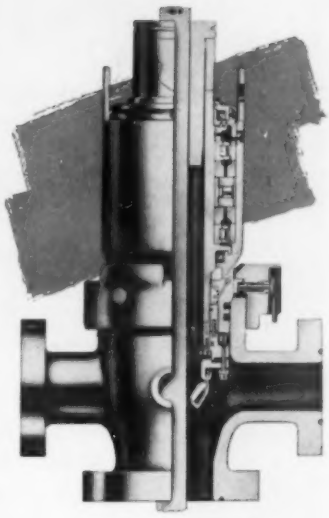
YOU SELECT THE METHOD...

The SHAFFER ROTATING BLOWOUT PREVENTER and STRIPPER Gives FULL PRESSURE PROTECTION AUTOMATICALLY!

USE THE TYPE 50 FOR HEAVY-DUTY WORK—including all types of drilling operations through 10¾" casing and larger!

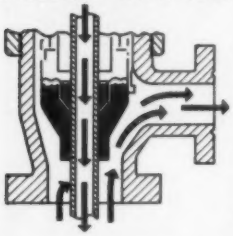
It's easy to see why the Shaffer Rotating Blowout Preventer and Stripper is the ideal pressure control solution to so many of today's advanced drilling techniques . . .

- Here's a unit that is *always* sealed off around the drill string as long as pipe is in the hole!
- It maintains its pressure-tight seal around *any* element in the drill string—square, hexagonal or octagonal kellys, flush joint, upset or coupled drill pipe, tool joints and drill collars (excepting, of course, such abnormally large diameter drill string tools as bits, reamers, scrapers and similar units).
- There's no delay when pressure emergencies threaten because the Rotating Blowout Preventer is *always* ready. No valves to open or close. No levers to operate. Nothing to remember—or forget—in emergencies!



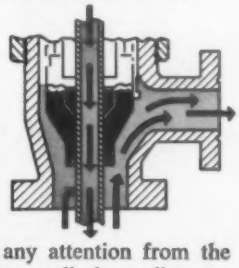
USE THE TYPE 51 FOR SLIM-HOLE DRILLING—also for drilling-in, for production and re-work jobs, and for similar applications.

DRILLING WITH AIR OR GAS?



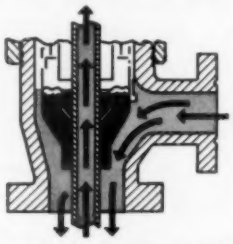
Operators are finding that many formations can be drilled faster, with longer bit life and increased production recovery by using compressed air or gas to replace the conventional mud column. Even wells in excess of 18,000 feet deep have been successfully drilled by this method, using the Shaffer Rotating Blowout Preventer and Stripper to seal around the drill string and maintain safe pressure control. The unit not only permits wells to be drilled more safely, but it also can readily be adapted to function as a casing stripper for pressure control while running casing, if desired. The 44 page brochure shown at right gives full details!

. . . AND FOR NORMAL OPERATIONS!



If yours are the more conventional drilling procedures, you still can do the job more efficiently and safely with a Shaffer Rotating Blowout Preventer and Stripper because this unit *automatically* adjusts itself to fit the varying diameters in the drill string without any attention from the operator. And even such abnormally large diameter drill string units as bits, reamers, and scrapers, can be readily passed through the Rotating Blowout Preventer without delay or inconvenience!

WHAT ABOUT REVERSE CIRCULATION?



This is another of the modern drilling techniques that provides important advantages in certain formations Because the cuttings are returned through the inside of the drill string, higher fluid velocities are obtained at lower pump pressures (therefore lower pressures on the formations). Higher velocities lift larger cuttings, reduce need for coring, save costly rig time. Also, since larger cuttings are carried away faster, bit life is lengthened, drilling speed is increased.
These are advantages worth investigating...and here, again, the Shaffer Rotating Blowout Preventer and Stripper is the ideal unit to control circulation and maintain full pressure protection while drilling!

THIS HELPFUL 44 PAGE BROCHURE provides full data on operation and applications. It's free to qualified personnel, engineers and executives!

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CASPER, WYOMING, Shaffer Tool Works, Post Office Box 1788
HOUMA, LOUISIANA, Shaffer Tool Works, Post Office Box 827
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Long Life Unit,
21 continuous hp

over 30 years proven top performance by WAUKESHA GAS ENGINES in the world's oil fields

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Send for descriptive literature.

10 to 1027 hp

61 to 5788 cu. in. displacement

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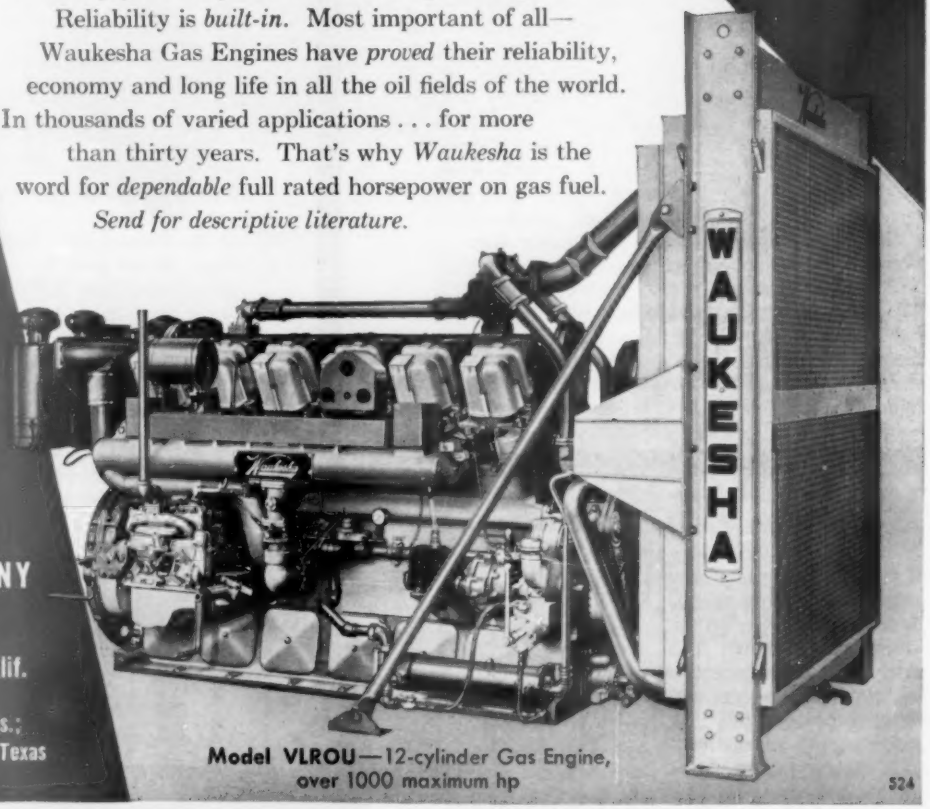

Model VLROU—12-cylinder Gas Engine, over 1000 maximum hp

524

pared to the income resulting from it are not badly out of line.

Q. How do you look upon the tubingless completion method for cost reduction?

A. It works fine, but I wouldn't want to use it in wells where we have substantial reserves.

Q. Does anything look promising to you at this moment for reducing drilling costs?

A. There are possibilities of amazing breakthroughs, in my opinion. One idea with which you are familiar is Gulf's fast drilling methods in the Louisiana Gulf Coast area. More or less conventional rotary equipment has been used. I have been quite surprised at the magnitude of the results.

Q. Any other comments?

A. Drilling contractors should not be disheartened because competition is tough. I am sure it is going to remain tough. The drilling contractor must, like anyone else in our competitive economy, figure out how to do the job cheaper and do it as he sees it. I have contractor friends who do that and seem to be getting along very well. I talked to one the other day who said 1961 was going to be one of his best years. Just cutting price is not necessarily the way to get a job. We are not keeping the price down. We're saying we want a certain job done and the contractor with the best tools, the best equipment, the best personnel and the best supervision and best prices is the one who gets it.

Q. In other words, you like to see them make a profit that provides a savings to you too.

A. Surely. We are not trying to keep them from making a profit. They set the price, we don't.

"Drilling has hit bottom . . . modest increases are to be expected"

Alvin C. Hope, independent producer and president of Independent Producers Association of America, San Antonio, Tex.

Q. Would you sum up the domestic industry's situation and tell us your views on the outlook?

A. The drilling outlook is naturally governed to a large degree by the outlook for the domestic petroleum industry. This in turn is influenced greatly by the overall energy outlook. Since 1956, the growth of U. S. energy requirements has slowed considerably from the post-war period when 6% increases were normal and has assumed a pre-war growth rate of 2 to 3% per year. During this period, natural gas and natural gas liquids have supplied all of the increase and U. S. crude oil production has remained relatively unchanged.

Since the value to the producer of natural gas on a Btu basis is only a fraction that of crude oil, the total income to the producer for the sale of oil and gas has not experienced the increase which might have been expected. As a matter of fact, total income to the producer from the sale of oil and gas was lower in 1960 than in 1957. Declining income, increased material and labor costs and a static price margin for crude oil have all been significant factors in the decline in drilling since 1956.

General outlook in drilling in particular: Greater growth in crude oil demand has flattened out in the last five years. During 1960, U. S. crude oil demand increased only 0.8%. Outlook for the next several years is for a growth rate of only about 1.5% per year. Natural gas and natural gas liquid growth will be more rapid than for crude oil. Demand increase for natural gas was 6% in 1960. Natural gas liquids demand was up 7%. Both gas and natural gas liquids are expected to maintain high growth rate relative to crude oil for indefinite period ahead.

With crude production allowables still severely curtailed in all major producing states and some 3,000,000 bbl per day shut in for lack of a market, the short range outlook for drilling does not seem to indicate any significant increase.

On a long range basis, the outlook is more optimistic. Assuming that imports are maintained at about the present ratio to demand and that it is desirable to maintain the present reserve ratio, the domestic producing industry would need to find on the average about 5 billion bbl of new reserves a year for the next ten years. This would undoubtedly require a substantial increase over present drilling rates.

Improved drilling technology and improved practices have helped keep costs down. Cost cutting has become the by-word. Slimmer holes, smaller pipe and improved fracturing techniques as well as other cost cutting ideas are being pursued by all concerned. Wider well spacing, tubingless completions, multiple completions and unitization are very much in the news. Harder times are spurring us on to find new ideas to keep our costs in line. Our information on cost is more up-to-date than ever before. The joint association survey of industry drilling costs conducted by the IPAA, API and Mid-Continent Oil & Gas Assn. is now on an annual basis. Weight of the various cost items over period 1947-1960 will indicate shifts in drilling cost, drilling improvement, drilling techniques, slimmer holes, etc.

Q. Do we have more or fewer

QA QA QA QA QA QA

independent producers today than we had five years ago?

A. I don't have a specific count, but the trend would indicate that we have fewer.

Q. Do you think the Internal Revenue Service rulings or lack of rulings on ABC transactions are going to affect property acquisitions?

A. In my opinion, if the ABC procedure is ruled out by the Internal Revenue Service, it will definitely lower the value of production.

Q. What in your estimation can the independent producer do to survive the economic squeeze?

A. There are three things that are definitely necessary in order to instill confidence of the investing public in the oil industry, which confidence is necessary if the independent is to survive.

First, we must firm up limitations on imports of crude and crude products specifically and residuals also must be limited to a lesser extent. It is more important to limit crude and products than to limit residuals.

Second, it is absolutely necessary that the present oil tax structure, particularly that portion of the tax relating to the 27½% depletion provision and intangible writeoffs, must be maintained on a firm basis.

Third, the gas industry is in most serious trouble if gas legislation is not enacted which would relieve the producers of cost-of-service utility type regulations. The basis for that observation is that demand is exceeding the rate of growth of gas reserves. If a firm gas bill such as the Harris bill now before Congress is enacted, with certain provisions eliminated such as the so-called anti-pancake measures, the prospector for gas can then proceed with confidence in exploring for gas and gas alone. Under that kind of legislation, with gas being treated as any other commodity, the consumer can be assured of a supply of gas at a reasonable competitive price.

Q. Are the independents today losing interest in looking for gas?

A. They have been losing interest in looking for gas ever since the last natural gas bill was vetoed.

Q. Statistics indicate the independents produce less than 40% of the nation's oil yet drill about 75% of its wells. In your opinion will this trend continue?

A. This trend will continue, if the three points enumerated above are put into effect. It is inevitable that the oil industry will continue. If the depletion provision and intangible writeoffs are eliminated, there will be a mass exodus of independents whose holdings would be acquired by the larger companies. Hence, the whole capital phase of the entire industry will be broadened and the oil industry will continue in some form or other with considerable chaos until it is shaken down. The end product will be that the consumer will pay considerably more for his product.

Q. What do you think about current cutthroat bidding practices among drilling contractors?

A. Such practices are bad for the industry. Whenever any branch of the industry fails to make a profit commensurate with the work done and the capital invested, it is unhealthy for the industry.

Q. Have you seen any signs among independents of streamlining and cost cutting as we've read about among the majors?

A. Definitely. We are possibly lagging some, but I think from an overall standpoint we are doing possibly as well. Take into consideration the fact that the majors do more experimentation . . . trial and . . . error than we do. They do more engineering which in itself is expensive. As a smaller independent, I am inclined to follow along because I do not have the engineering help available to me that the majors do.

Q. Is there an economic advantage in contracting most of the work done for you?

A. Yes. I find there is an economic advantage and have thought so for quite a number of years. As an example, I sold my last drilling rig in 1952.

"Total demand . . . will increase to 11,975,000 bpd in 1970."

Edward E. Monteith Jr., vice president, Republic National Bank, Dallas, Tex.

Q. Has the domestic oil picture lived up to your expectations this year?

A. Our studies have been on a ten-year basis and were not primarily aimed at this specific year. However, domestic demand has increased only 1.5% over last year compared to our average estimate of 1.9% per year for the next ten years. Domestic crude oil production has exceeded our prediction of an average increase of 1.6% per year. This is reflected in the increased level of inventories. Texas has continued to suffer under low allowable days, but we anticipated these early in 1960, and did not expect any great increase in 1961; nor do we expect

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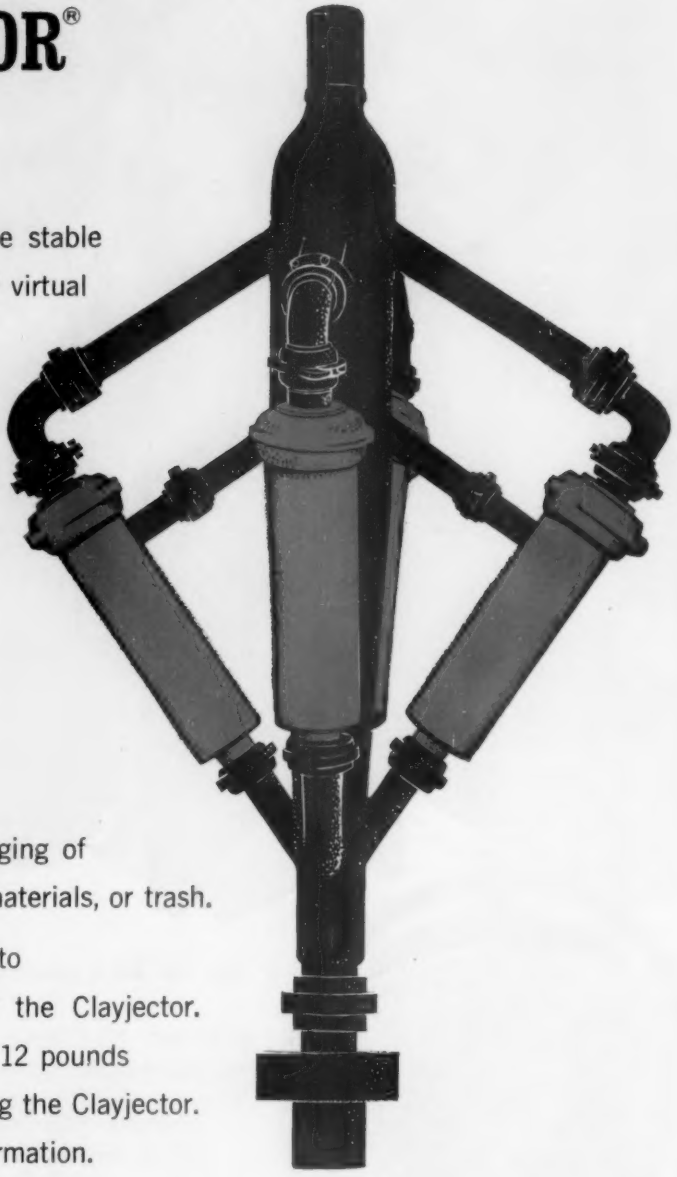
NEW . . .
THE SWACO
GOLDEN CLONE
CLAYJECTOR®



Three major improvements result in more stable operation, greater ease of adjustment and virtual elimination of plugging.

New Golden Clone* cyclones feature a ceramic lining so wear-resistant that clone dimensions so essential to efficient operation remain unchanged even after months of use.

New pressure regulator for feed holds uniform correct pressure on cyclones. Single valve adjustment of dilution simplifies operation.

New SWACO Auto-Screen* prevents plugging of unit with drilled solids lost circulation materials, or trash.

These improvements have added greatly to the already outstanding performance of the Clayjector. If you are drilling with mud heavier than 12 pounds per gallon, you can cut mud costs by using the Clayjector. Ask a SWACO representative for full information.

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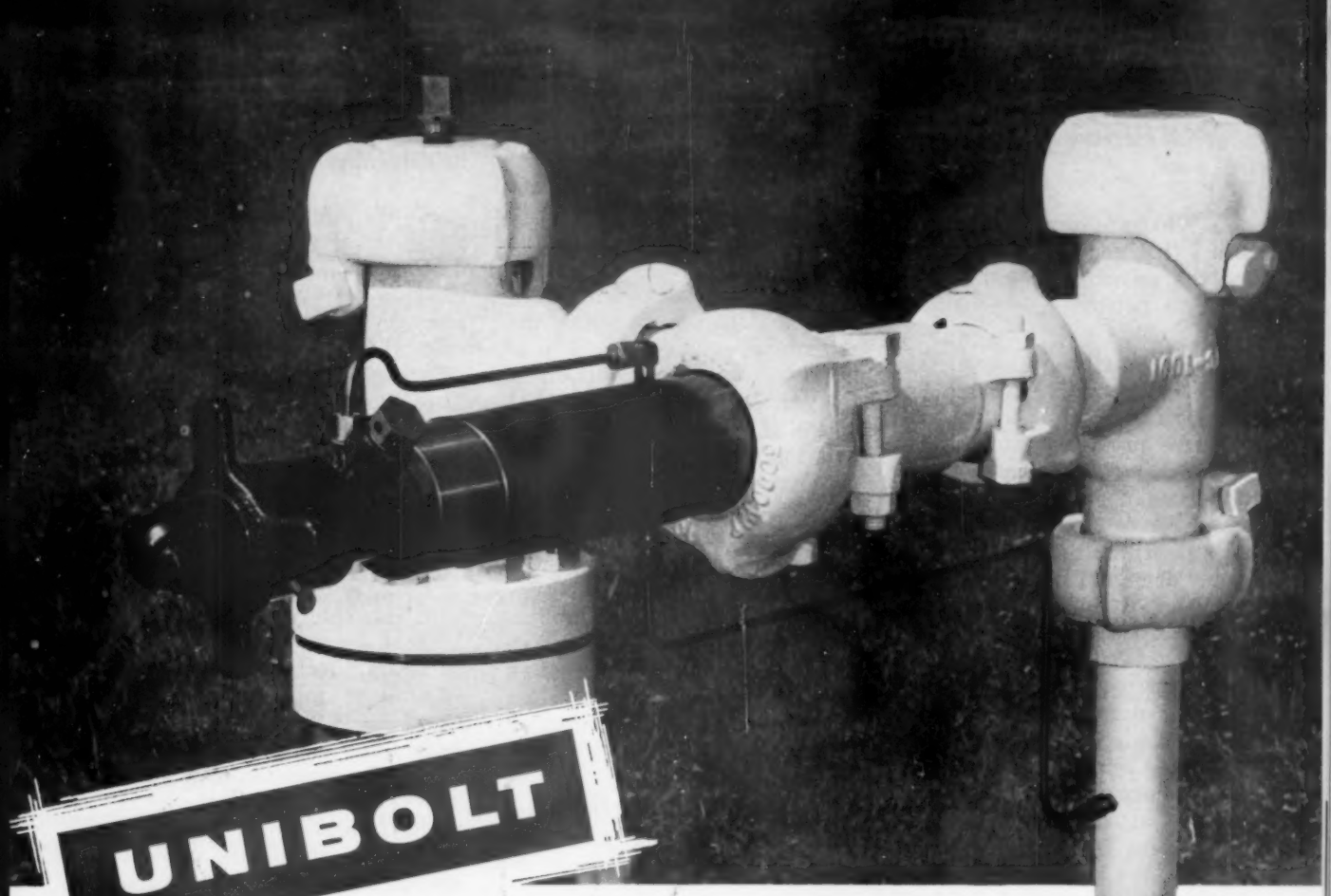

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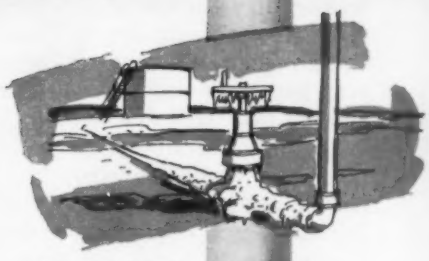
Provide dependable, low-cost insurance against all flow-line hazards

Here is a valve that does the work of two valves yet costs little, if any, more than a good high pressure valve. It is both a high-low safety and a Christmas tree wing valve.

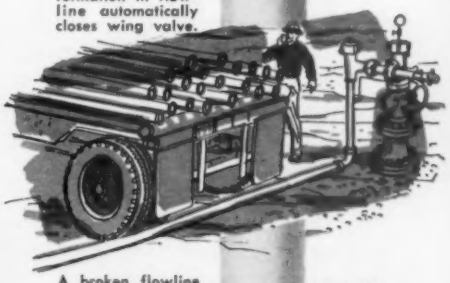
The UNIBOLT PRESSUREMATIC VALVE combines all of the time-tested and proven features of the Unibolt Adjustable Wing Valve with a novel automatic actuating accessory. The valve closes instantly when a predetermined pressure balance across the seat is disturbed. The actuating mechanism consists of a small piston which is exposed to well pressure and a larger piston which is exposed to flowline pressure. A broken flowline or open valve, for example, in the production system, would lower the flowline pressure and thus instantly close the valve. Once closed, the valve may be easily opened and set manually for automatic operation. The downstream or low pressure line may be tapped at any remote point and thus embrace any desired portion of a gathering and treating system. Offshore and other remotely controlled wells could be shut in automatically in case of fire, ship collision, etc. The unique design lends itself to many such applications.

Send for literature or contact your nearest Unibolt sales representative.

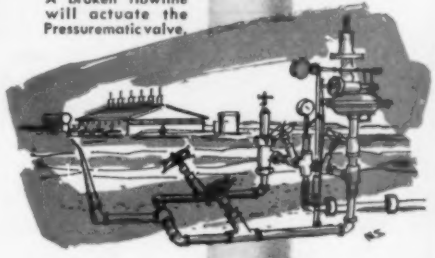
YOU CAN CONVERT YOUR UNIBOLT ADJUSTABLE WING VALVE TO "PRESSUREMATIC."
The regular UNIBOLT Adjustable Wing Valve can be readily converted to "Pressurematic" by replacing the stem/bonnet assembly with the Pressurematic unit.



Freezing or hydrate formation in flowline automatically closes wing valve.



A broken flowline will actuate the Pressurematic valve.



Failure of a pressure regulator on pipe line gathering manifold would shut in the well.

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THORNHILL CRAVER CO.

P. O. Box 1184, Houston, Texas

QA QA QA QA QA QA

a great increase in 1962 over this year.

Q. What are some of the indicators that you used in evaluating the economic health of the domestic petroleum industry?

A. Our studies are based primarily on historical demand for the various crude products that we have predicted into the future. We have reduced these to the basic denominators of demand per capita where possible and then multiplied the projected demand per capita by the predicted population at the appropriate years. We tried to predict inventory levels and any reduction or build-up in these levels in our effort to estimate crude supply for the short term. We also studied the general level of the economy and expected increases or decreases for the short term in overall business activity. We are particularly interested in estimates of the short range allowable picture in Texas and Louisiana over the next five-year period. In working on these predictions, we attempted to estimate demand for Texas and Louisiana crude and then subtracted estimated marginal production that is proration-exempt to arrive at the remaining prorated oil. By estimating the successful prorated oil wells drilled over the next five-year period, we arrived at the total prorated supply vs the total prorated wells and reduced this to allowable days. Since other states, such as Colorado, Wyoming, and Montana, are prorated primarily by pipelines, we used historical production amounts after checking with the crude oil purchaser. We consider the prediction of allowables in Texas and Louisiana to be our most critical short-term problems.

Q. How does the long-term picture look for the domestic producer?

A. We think the long-term picture for the domestic producer looks relatively good and very encouraging. While we think the number of wells completed as producers in the U. S. will decline each year over the next ten years, we estimate the demand per well will increase, and thus the economics of the remaining producers will progressively increase over the next ten years. If imports are held at 18.4% of total domestic demand and total domestic demand increases by 1.9% per year and the number of wells drilled per year constantly decreases, the production per remaining well in the U. S. must inevitably increase. In ten years the production per prorated well should go up very substantially. Assuming operating costs go up less rapidly, profit per producing oil well should materially increase.

Q. What part of the total energy picture will petroleum play in the next ten years?

A. We estimate that by 1970 crude oil will be providing 39% of total energy requirements of the U. S., natural gas will be providing 34% and natural gas liquids will be providing 4½%.

Q. How does that compare with 1960?

A. In 1960 crude oil was supplying 40.97%, natural gas liquids 3.91% and natural gas 28.38%. Natural gas is the fastest growing source of energy by far, and crude oil will lose its position percentage-wise to natural gas and to natural gas liquids. By 1970 we estimate that gas and natural gas liquids will be providing slightly more of our total energy requirements than crude oil (energy expressed in British thermal units, where one cubic foot of gas equals 1050 Btu and one barrel of oil is figured at 5,800,000 Btu).

Q. Do you have any information on the trend of reserves-to-production ratios for crude oil or natural gas over this period?

A. We think the ratio of years' reserve to annual production of oil will decrease over this ten-year period from 12.3 average over the last two or three years to 11 by 1970. Years' supply of gas will decrease from 21 to 19 over the next ten years. This is almost a straight line projection.

Q. What has been the picture on imports in the last several years?

A. Our information shows all U. S. imports, including crude oil and products, have averaged 18.42% of total domestic demand in 1959 and 18.41% in 1960. They have averaged this percentage since the mandatory import controls went into effect. While total imports have continued to increase, the percentage of total domestic demand has remained constant.

Q. Approximately what have imports been averaging in barrels per day in the last few months?

A. They are running about 1,818,000 bpd. Total U. S. demand has grown less rapidly in the last five years since 1956 compared to the postwar years. Imports have stabilized apparently at about 18.4% of demand, leaving the available liquids supply to be split between the natural gas liquids and domestic crude oil. Total U. S. supply, which is production, has dropped since 1957. Domestic crude oil peaked in 1957 at 7,169,000 bpd and last year was 7,320,000 bpd. We estimate that the trend will reverse and go back up over the next ten years and that by 1970 it will reach 8,100,000 bpd. Crude oil and natural gas liquids together should reach 9,750,000 bpd by 1970. There will be an increase in natural gas liquids

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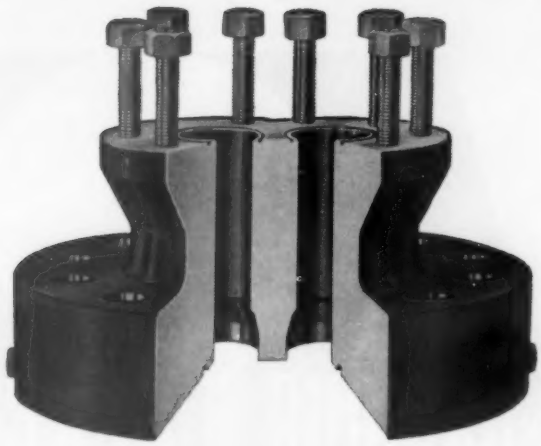

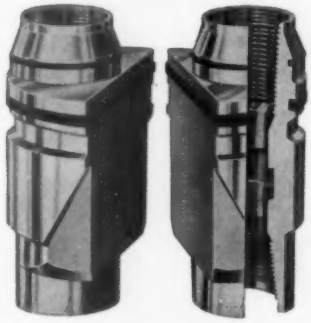

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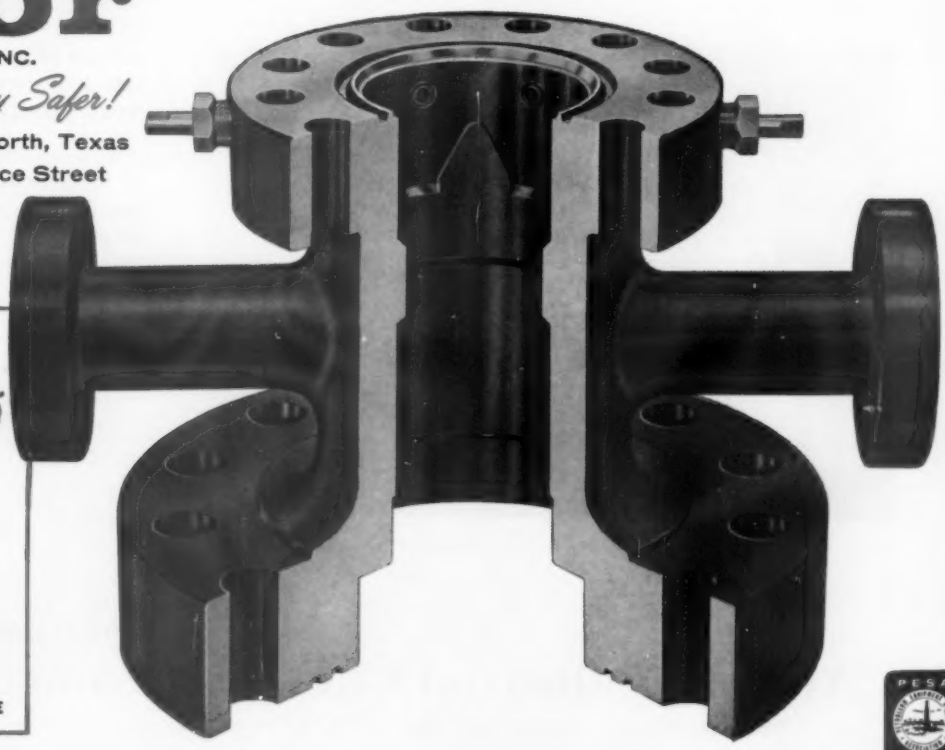

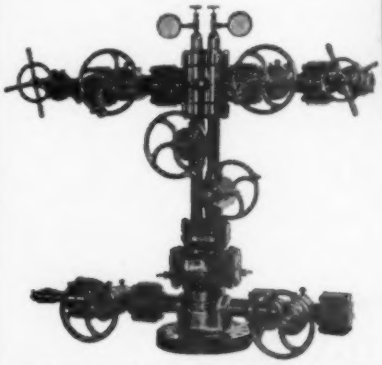

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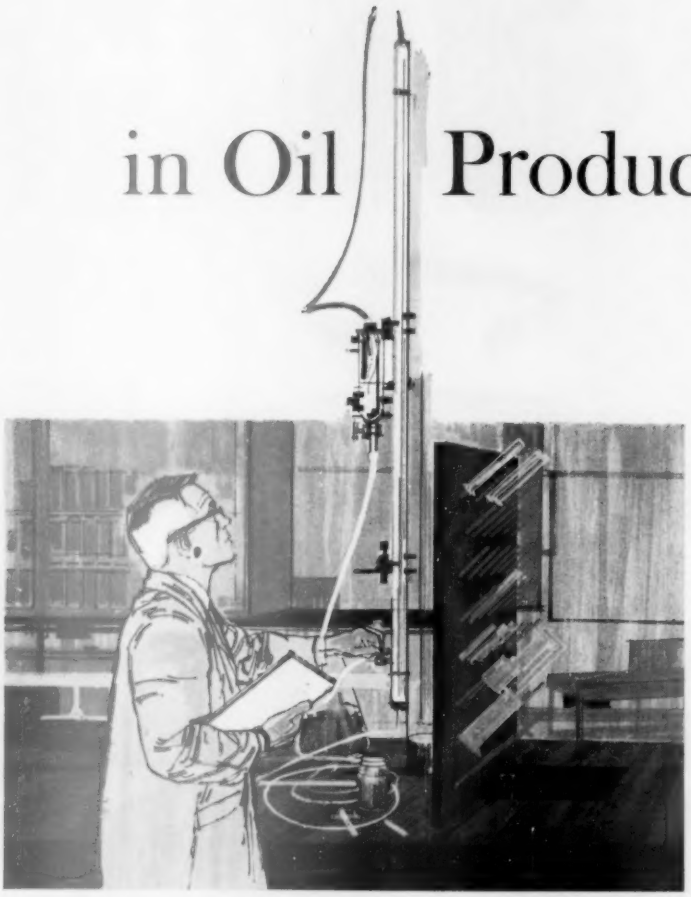

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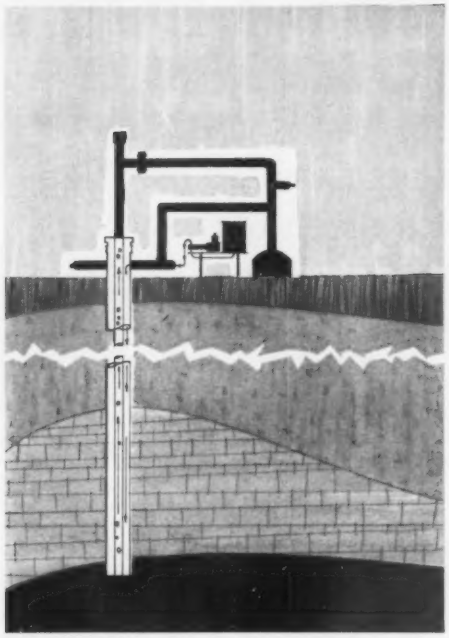

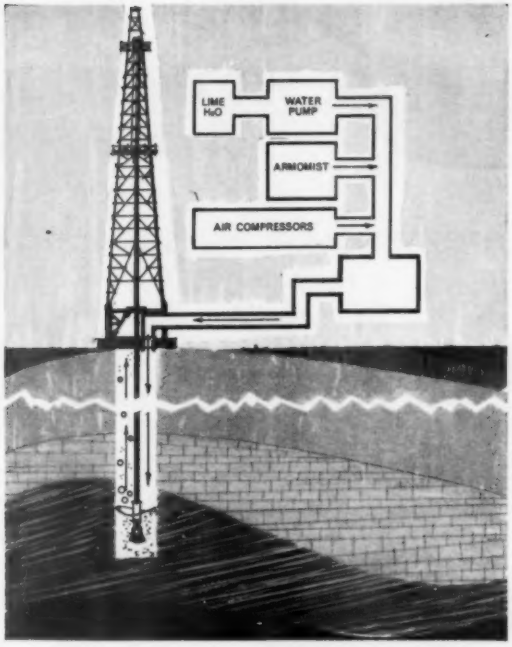

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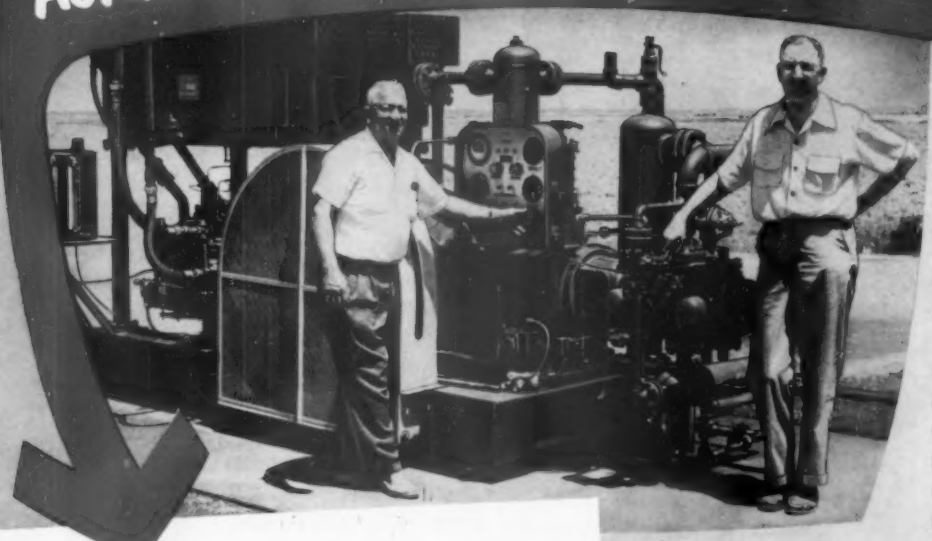

Two of Mr. Payne's happy customers: Clyde Allison (left) and L. F. (Lou) Andersen, independent oil field production service operators, Co-owners of A & A Production Service Co. (Glenn, Calif.)

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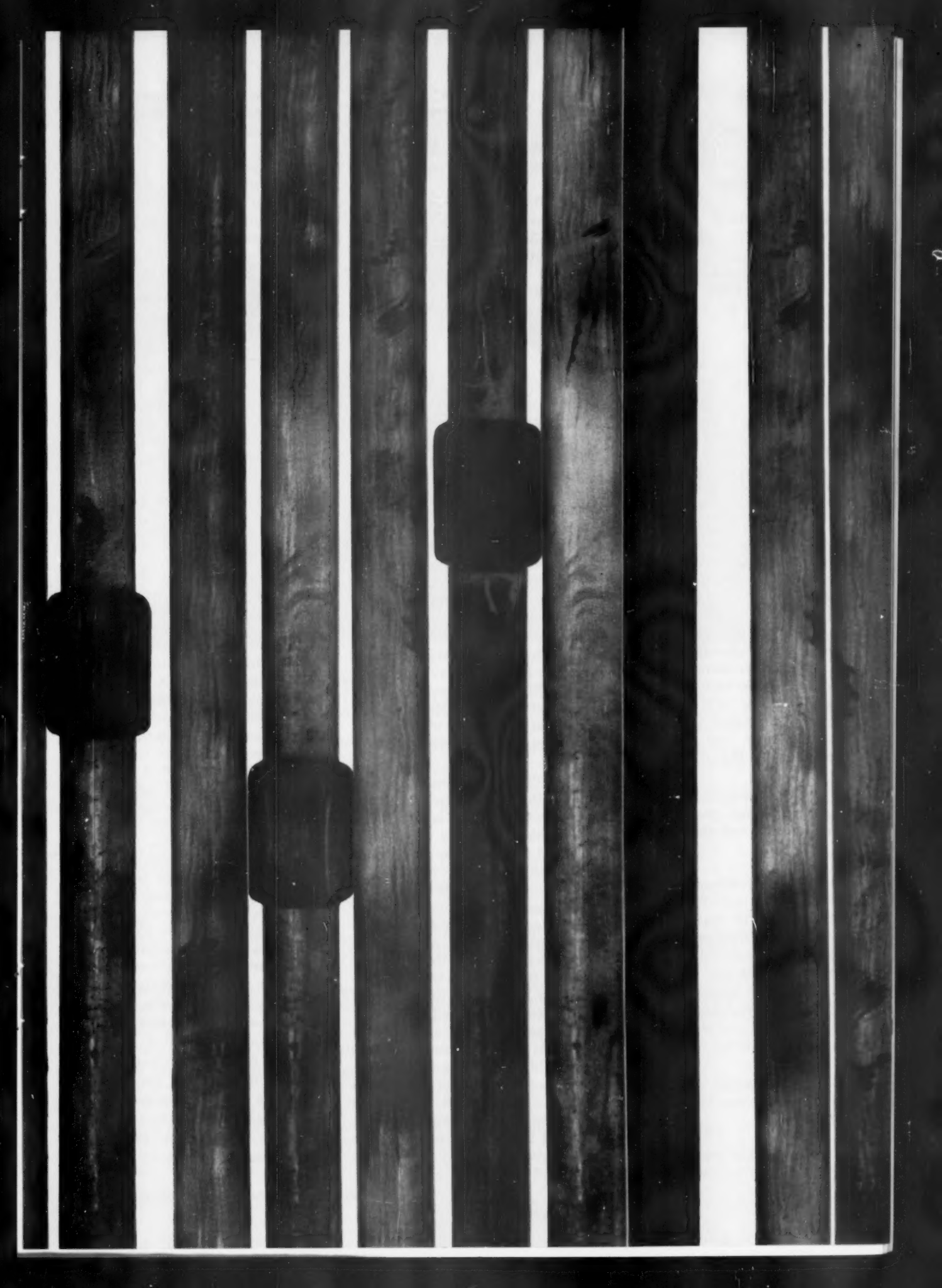

QA QA QA QA QA QA

supply in the next ten-year interval and by 1970 gas liquids will be about 17% of total domestic production.

Q. What about natural gas liquids for 1957 and 1960?

A. Natural gas liquids production for 1957 was about 965,000 bpd. In 1960 it was 1,127,000 bpd.

Q. What is the overall U. S. demand picture for 1960 and 1970?

A. Total demand for all products including imports will increase from an average of 9,879,000 bpd in 1960 to an average of 11,975,000 bpd in 1970.

Q. What petroleum products, if any, show the greatest promise for substantial gains in U. S. demand?

A. Motor fuel (gasoline) and jet fuels indicate rapid increases in demand. We show jet fuel increasing at the rate of 6.7% per year for the next ten years. Motor fuel totalled 1,532,000,000 bbl in 1960 and will reach 1,833,000,000 bbl in 1970.

Q. What does your forecast show regarding the increasing number of motor vehicles in the U. S.?

A. Number of motor vehicles in the U. S. was 73,564,000 in 1960. By 1970 this should increase to 92,100,000. This is based on a combination of population increase and vehicles per capita. We projected population and vehicles per capita and multiplied these to get our total motor vehicles for 1970.

Q. What about natural gas production over this ten-year period?

A. In 1960 it was 35.4 MMcf per day. In 1970 we predict it will be 50.5 MMcf per day.

Q. What are the reserve figures on those two periods?

A. Our proven reserves in 1960 were 273 trillion cu ft and we estimate in 1970 they will be 350 trillion cu ft.

Q. What effect do you think FPC regulations have had on exploration and development of natural gas?

A. FPC regulations have been a strong deterrent to the search for natural gas. Area prices certainly are a more logical approach than utility rate base approach. As to the long term equity of area prices, I think that any FPC prices should be based on arms length, competitive bargaining between sellers and buyers. Anything less will be a deterrent to the realization of true economic value of gas at the wellhead.

Q. Do you think the recent Internal Revenue Service rulings on ABC transactions or their lack of rulings will have any marked effect on oil and gas property acquisitions?

A. They will temporarily inhibit the sale of properties because the seller is not sure whether he is going to realize a capital gain on 75% of his sales price in most cases. If he has to pay normal income tax on 75% of his sales price, which is the part that has previously been simultaneously reserved and sold as an oil payment, I think he will delay selling until this is clarified. If he now has to sell, it will be necessary to sell to a substantial party who in six months sells to somebody else. This will probably result in a reduction in the net price received by the seller. The second party will have to make a substantial profit out of it before he will sell it to someone else.

Q. Based on your knowledge of the industry, its economics and regulations, what do you think will happen to the independent producer as we know hom today? Will he be as significant a part of our industry ten years from now as he has been in the past ten years?

A. I don't think he will be as significant in the domestic production picture as he has been in the past ten years. Economics point toward integrated operations and I think the search for oil has become so highly competitive that the average independent cannot afford to search competitively for oil with the big integrated companies.

Q. What about the drilling picture in the U. S.?

A. In 1960 a total of 46,778 wells were drilled. In 1961 we predict about 47,500 wells will be drilled. In 1962 we predict about 45,500 wells, and by 1970 we predict approximately 40,000 wells. Thus, we anticipate a gradual decrease in the number of wells drilled over the next ten years. This study was based on the number of development wells drilled per successful exploratory well drilled. We first had to study the number of total exploratory wells drilled per year and we noticed that they seemed to be leveling off. We predict they will level off at around 13,000 wells drilled per year for the next ten years. About 19½% of all exploratory wells have been successful in the past ten years and that ratio should continue for the period studied. However, we note that the number of development wells drilled per successful exploratory well is constantly decreasing and it seems to follow a two-year delay ratio. In other words, two years from the time a discovery is made, the fields experience their complete development. In 1941 a hundred development wells

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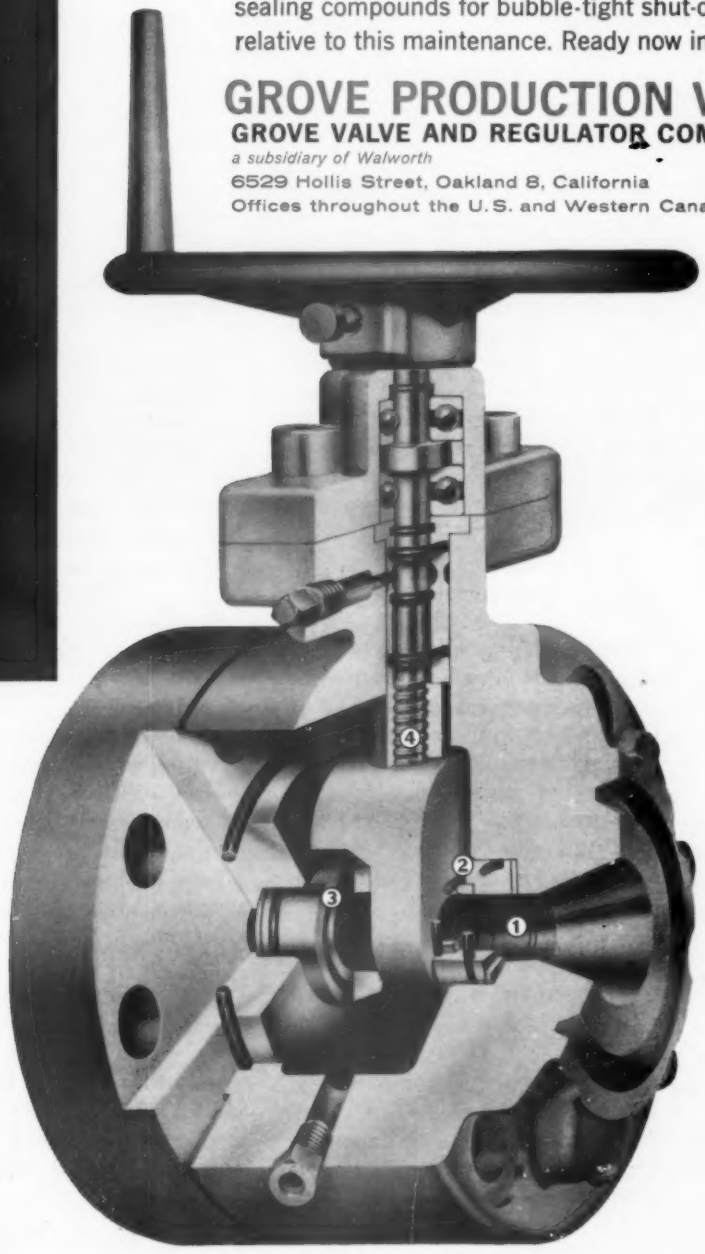

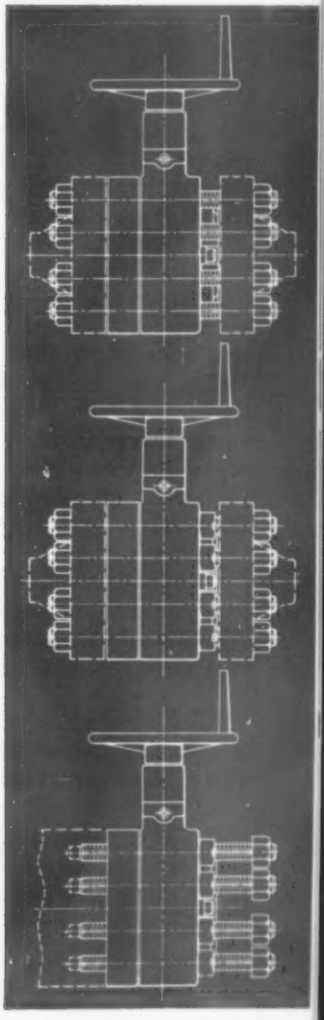

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were drilled per successful exploratory well. This ratio decreased until in 1960 it was down to 13.2 development wells per successful exploratory well. We predict a continued decrease to ten development wells per discovery well in 1970. This reflects the decreasing size of fields found in the U. S. It also reflects multiple completions and wide spacing, but I think it is caused primarily by the fact that the fields found are becoming smaller. We show a continued decrease in total wells drilled from the peak in 1956 until about 1970, at which time our prediction tends to flatten out at an estimated 40,000 wells per year.

"West Coast drilling outlook about same as this year"

Robert C. Sharp, vice president, Caldrill, Inc., Ventura, Calif.

Q. From your observation, do independents or major producing companies drill more wells on the West Coast?

A. In normal years, the major companies lead by quite a large margin. A flurry of activity and shallow wells in the Sacramento Valley gas country are factors that may have brought more small independent firms to the scene to throw the proportion somewhat off norm in the last few years.

Q. What is the general outlook for drilling activity on the West Coast for the remainder of this year and next?

A. Very similar to last year, which was below the previous five or six-year average.

Q. Do you have any ideas concerning the long-term outlook for drilling activity on the West Coast?

A. Frankly, at present the long-term outlook appears no better than the short-term outlook simply because California oil is becoming very expensive to find and produce. California has been geologized and drilled probably as much or more than any area in the world. Leases are very expensive, particularly in the Los Angeles Basin, so it is quite costly to put together a play of any size.

Q. Approximately how many rigs are running now?

A. Between 70 and 80 actually drilling in California and one or two in Oregon and Washington — about 55-60% of the total number of rigs available.

Q. What are your thoughts regarding the adequacy or inadequacy of drilling crews and supervisory personnel?

A. I think the quality of personnel the drilling industry attracts is getting progressively worse because of intermittent activity. Even though our rate of pay per hour is 40 to 50% higher than other areas, men are looking for steady work with security and fringe benefits.

Q. As a manager, what do you feel are some possible solutions?

A. Continuity of work which, of course, is very broadly tied in with the general economics of the drilling industry, offers the best solution. When you have a surplus of rigs and attendant low prices, you can't offer work continuity. In the past, we could keep men on the payroll between jobs. Today, we can't.

Q. Do you care to comment on union activities on the West Coast?

A. We have two companies of identical ownership — Caldrill Inc. and Caldrill Offshore Inc. On two offshore operations we are unionized. We are not unionized on shore, but we pay about the same wages and general benefits as we do offshore.

Q. What is the union?

A. The Pile Drivers Union, which is affiliated with the Carpenters Union of AFL-CIO.

Q. What is the average hourly pay for a driller?

A. The driller receives $4.30 per hr for a 42-hr week.

Q. How about pay in transit?

A. We pay a travel allowance at straight time only on water. Contractors do pay subsistence in some parts of California where rigs are scattered, as in the Sacramento Valley area. It is a variable situation.

Q. Have you noticed any change in recent years in contractor-operator relationship?

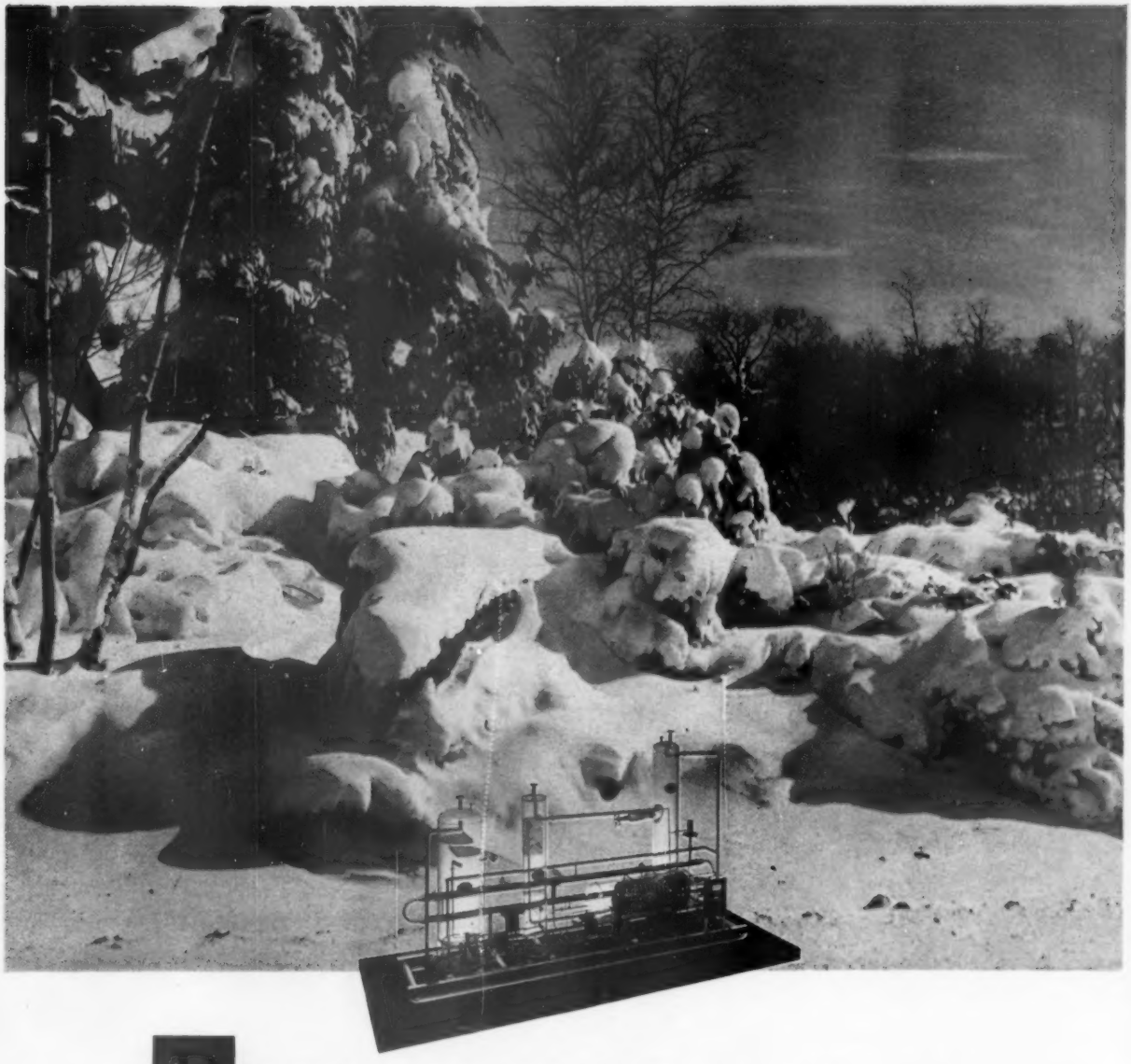
A. In some cases, yes. New men are coming into positions of responsibility with major oil companies, and because of the cost squeeze, they are at times overly concerned with the low bid rather than with adequate performance and total costs.

Q. How can this relation be improved to the benefit of the operator?

A. We are making an attempt in this respect in California where we have had committees of contractors calling on top management to tell them some of our problems with a view towards a mutually advantageous solution.

Q. How about the cooperation after the bid is let?

A. In most cases, very reasonable. Our big problem is those evaluating bids who seem to be concerned solely with the low



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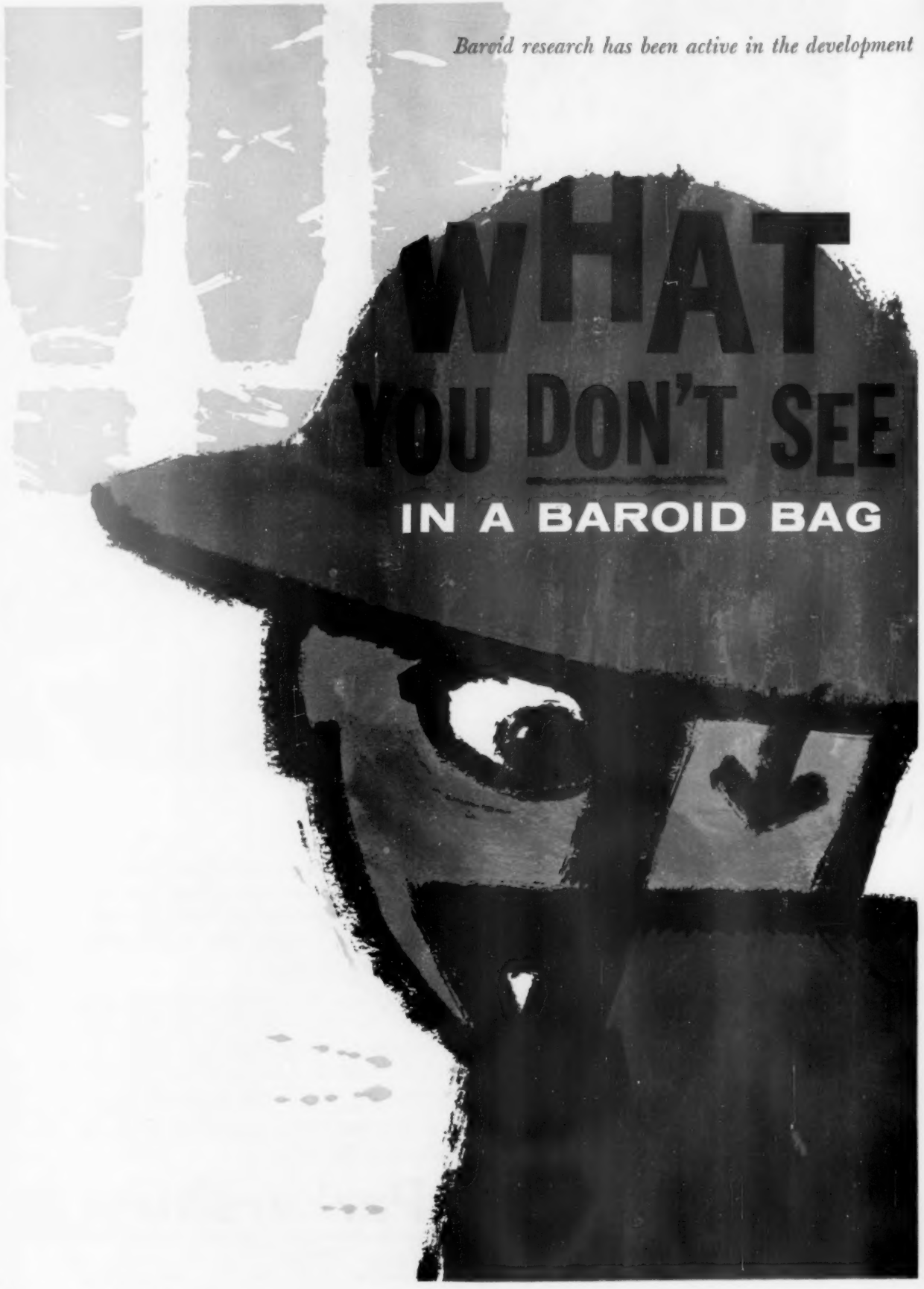
Baroid research has been active in the development



of every major break-through in drilling fluids!

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What you *do* see in a Baroid bag is just part of what you get. Behind each product stands technical knowledge gained from over 30 years of field engineering experience. Complete service from mines and plants to the rig makes Baroid the leader in product development and application.

Improved products and services are assured by the most extensive drilling mud research program in existence. New processes and streamlined operations reduce *your* costs.

Baroid has had an active part in the major break-throughs in drilling fluids. Baroid will be on the job when future break-throughs are accomplished!

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bid rather than with the quality of the equipment and crews.

Q. Is there much turnkey contract drilling going on in California?

A. It is the exception, probably 5% of the total work and mostly by smaller independent companies.

Q. Do you think this trend is stabilized or might it grow with the economic squeeze?

A. I doubt the latter. Major oil companies have departments set up to handle this phase, and I have noticed no increase in turnkey bids we receive.

Q. What in your opinion is a reasonable return for contract drilling, i.e., what percentage net profit after taxes?

A. Considering the risks and hazards inherent in contract drilling, and in order to replace worn-out equipment, we would like to receive 10% on invested capital. As all other contractors in California, we are a long way from that figure today.

Q. Is there any practical answer to this critical problem of underbidding?

A. We have made many attempts but, to give you an honest answer, I see no very hopeful sign that we can solve it immediately. I think it is a matter of some rigs getting out of the market.

Q. Accepting the fact that we can't alter significantly the operator practices in seeking bids and making contracts, generally what can a contractor do to combat the economic squeeze and still realize a reasonable profit?

A. I would say that a contractor, if financially able, should include a reasonable use or depreciation factor for his equipment and, if he can't realize that price, he should rack the rigs and wait until the situation is clarified. This is obviously a difficult decision.

Q. Have contractors taken measures comparable to producers in reorganization, streamlining, centralizing purchases, etc., to achieve economics in increased efficiency?

A. Most contractors here are relatively small companies and are about as streamlined in organization as they can get. I do think many efficiencies in drilling operations could be achieved if we could purchase new and better equipment. We have not been able to do this at today's prices.

Q. What major rig items could be improved in your opinion?

A. I would like to see: better designed, lighter weight drill pipe; lighter engines, such as the turbine which offers possible advantages in moves, and in higher horsepower per pound; more d-c electric rigs because of their flexibility and lighter weight; and better designed, high horsepower pumps to achieve better hydraulics. Drawworks might be improved in design, but I can't visualize anything that would replace them.

Q. What is the most promising drilling technique on the West Coast today?

A. California does not lend itself to air drilling to any great extent, but big improvements have been made in hydraulics, jet bit drilling and mud control.

Q. What about high speed drilling, as off the coast of Louisiana?

A. We have been doing that in California for some years, if, by high rotary speed, you mean in the 250 rpm range. Also, high hydraulic horsepower is not new here.

Q. Is slimhole drilling much of a factor in California?

A. It has been tried in many areas and is applicable in some of them, but I would say that it has not increased in recent years.

Q. Have you noticed any trend toward multiple completions?

A. Yes. This is, and probably will continue to be, an increasing development.

Q. Are there any tubingless completions?

A. Some companies have been experimenting with tubingless completions, but it is not widespread.

Q. What about California offshore developments?

A. Many of the companies, particularly four or five of the majors, are conducting research in underwater completions. These wells are being drilled from floating vessels, a technique which shows promise but leaves much to be desired because of the time involved in completion work. Drilling core holes from a floating vessel has been very successful, but drilling a completed well from a floating vessel takes more time than a fixed platform or on land. We haven't yet developed the tools to drill and complete these wells in a hurry from a vessel that is floating.

Q. Does the offshore picture look good?

A. I would answer with a cautious "yes." There is going to be considerable activity. They have not found a Signal Hill or Santa Fe Springs yet, but perhaps they will. There is a lot of unexplored area along the coast. They will continue to look, I am sure, although it is extremely costly.

Formjel gives a penetration block ...not just a well bore coating!

Formjel gets results where other methods fail because it penetrates and blocks *within the formation* rather than at the well bore alone. Another exclusive BJ Service development, this tough blocking agent has a variety of applications in acidizing and fracturing. It can be spotted to block one zone while another zone is treated . . . to stop channeling behind casing set through pay zones . . . to seal leaking packers . . . to block formations above or below a packer against vertical communication . . . and to help achieve multiple fractures. Formjel has exceptional viscosity, zero API fluid loss and can carry solid blocking materials. Available in Regular Formjel which breaks completely in 5 to 24 hours, or in Long-Lasting Formjel which provides positive blocking action for up to 16 days.

For complete details, call your local BJ Service field station today.

Results talk!

Formjel Stops Mud Loss Into Production Zone Where Oyster Shells Failed in Carter County, Okla.

PROBLEM: To stop mud loss into Flat Top Formation during cleaning out and milling operation. 1,600 lbs. of oyster shells—a solid blocking agent that is usually effective—failed to stop lost circulation, which reached 50 bbls./hr.

SOLUTION: Formjel was applied through the drill pipe in two 1,000-gallon stages. It effected a reduction in mud loss to less than 1 bbl. per hour for the remainder of the cleaning-out period—one week.

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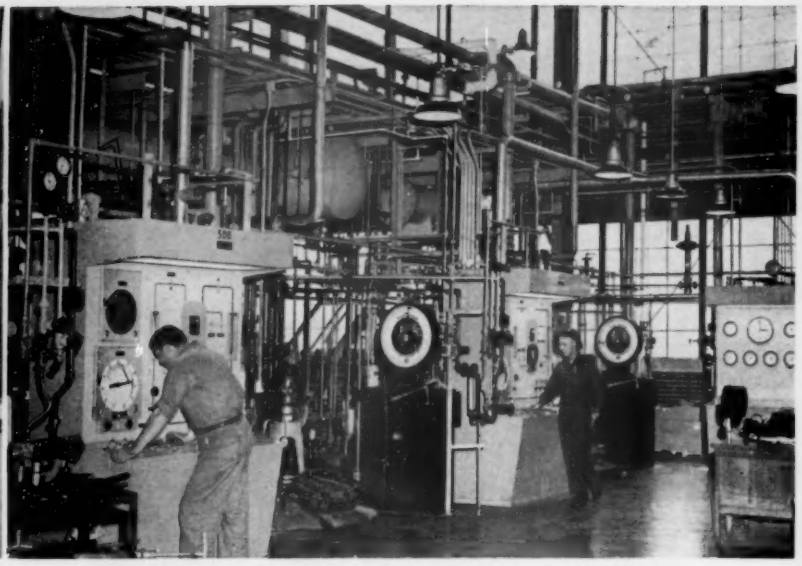
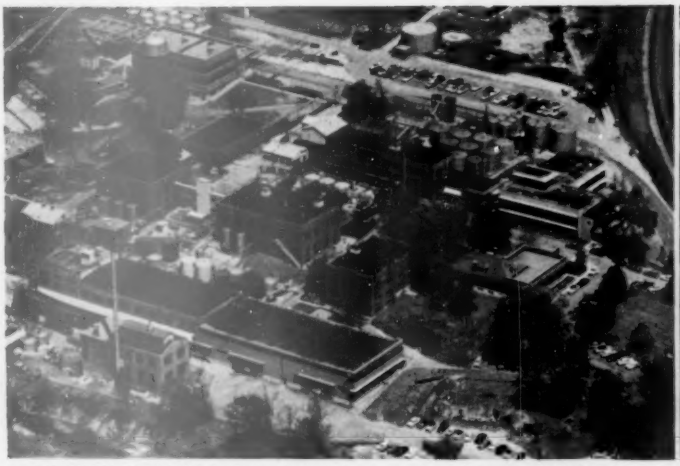
EMULSION SAMPLES are carefully tested in research laboratory at Brea, California. Tretolite technicians continuously seek new products to answer industry needs.



CONTROL CENTERS at St. Louis (illustrated), Brea, and Odessa, Texas, plants utilize latest equipment to insure uniformly high quality of Tretolite products.

RESEARCH...EXPERIENCE



PRODUCTION FACILITIES in St. Louis include research and development headquarters with pilot laboratories. Tretolite's founder, who originated the use of chemicals to break oil-and-water emulsions, was a St. Louis chemist.

CALIFORNIA PLANT at Brea is one of network of manufacturing operations providing widespread distribution of Tretolite products.

COMPANY-OWNED WAREHOUSE at Odessa—like those in St. Louis; Brea; Houston, Texas; Great Bend, Kansas; and Liverpool, England—facilitates prompt, economical deliveries.

ALWAYS AVAILABLE for on-site testing, computations, and recommendations is Tretolite field service engineer, shown here taking line sample at ACT station.

SERVICE ENGINEERS' assistance is offered wherever oil is produced or refined. Company planes are used to reach remote and off-shore locations.

IN-FIELD TESTING by the Man in the Red Car is familiar and valuable to oilmen in Canada, Latin America, and overseas, as well as in United States.

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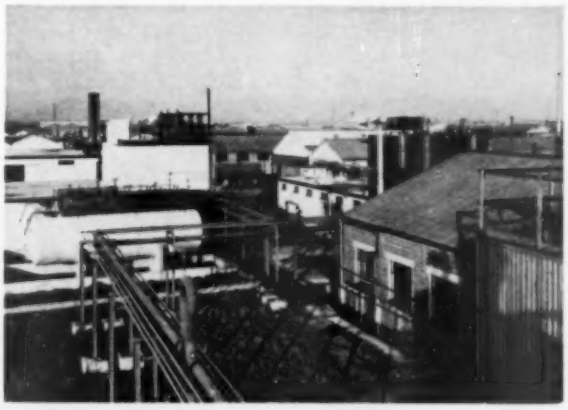
Among the "ingredients" in every drum of Tretolite products are the company's unparalleled research, experience, and service—directed toward the most effective possible treatment of petroleum at the lowest cost. Tretolite's extensive laboratory and field research, constantly seeking new and better formulas, has produced more than 600 oil-treating patents. Tretolite pioneered in this highly-specialized work almost 50 years ago, and today maintains a larger staff of field service engineers than any other supplier of petroleum demulsifiers, corrosion inhibitors, paraffin removers, and other additives and preventives. For help in saving dollars wherever you treat crude, ask the Man in the Red Car.



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TP-61-2

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Celite diatomite filter aids remove oil, amoebae, algae and bacteria from injection water. By eliminating pore-clogging suspended solids, pumping pressure and costs are kept low and oil recovery kept high. Data from a 10,000-barrel-a-day installation show that Celite, as compared to sand, reduced hold-up time from four hours to only 30 minutes. What's more, additional reports show backwash water requirements can be reduced up to 90%.

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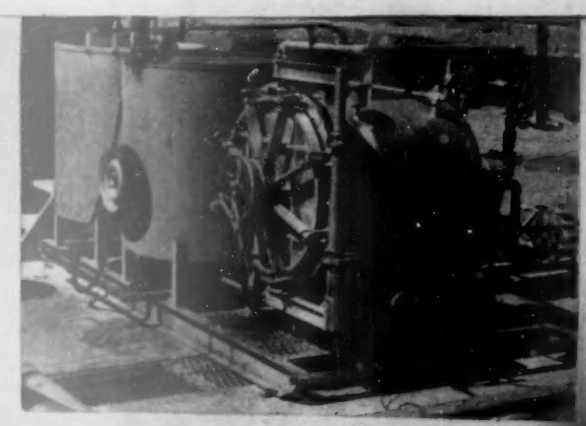
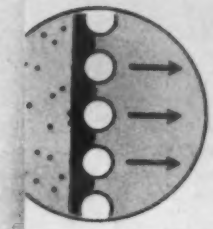
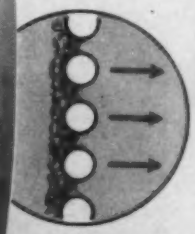
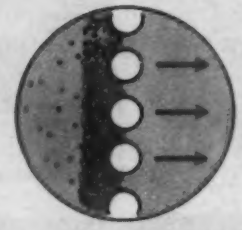




WITHOUT CELITE, fine suspended solids form a clogging seal over filter openings.



WITH CELITE, a porous cake with microscopic channels becomes the real filter surface.



DURING FILTRATION, continuous bodyfeed of Celite builds up fresh filter surfaces, greatly extending cycle life.

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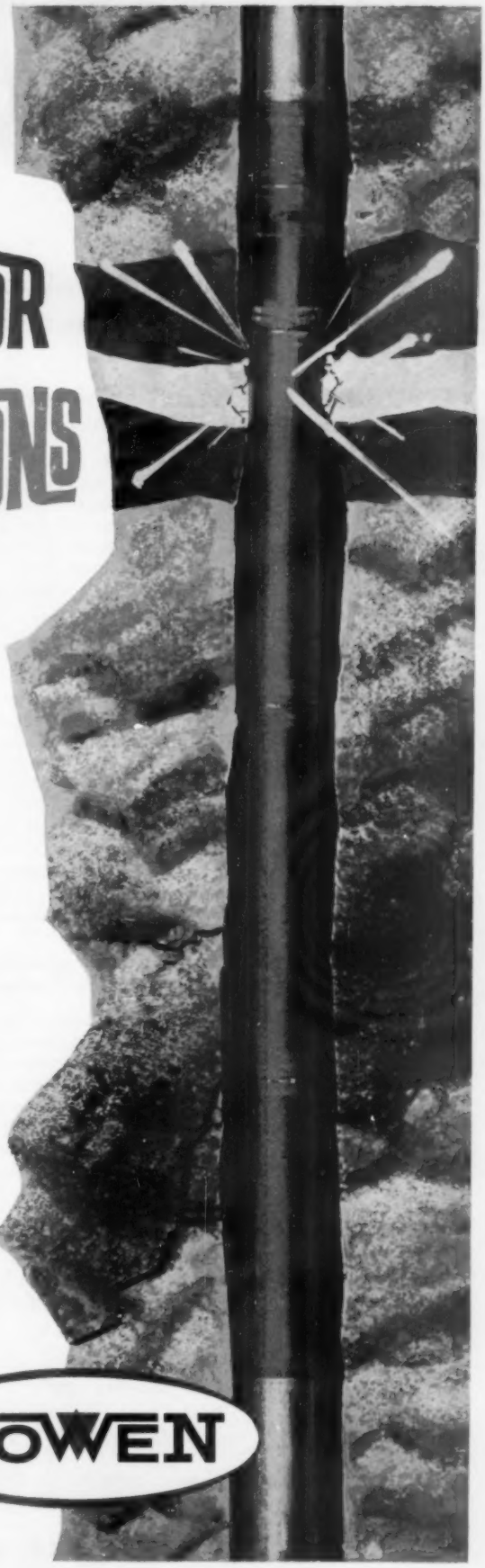

A stuck drill string is expensive and time consuming

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Run as an integral part of the drill string, the bumper sub allows immediate bumping action — **upward or downward** — to keep cuttings or cavings from wedging the string.

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Bowen Drilling Bumper Subs can also be used to great advantage in fishing operations.

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FROM HALLIBURTON

Wide Range of Halliburton Fracturing Treatments Succeed Where Others Fail

Vis-O-Frac Yields 500% Increase Where Nothing Else Succeeded

Allen Parish, La. — Other types of fracturing jobs had been tried in this area — with no appreciable results due to sand-outs. Then Vis-O-Frac treatment was performed for a major operator and yielded a 500% increase in production from 180,000 cu. ft. per day with 125 psi surface pressure to 880,000 cu. ft. per day with 1,550 psi surface pressure. This old well produces from Oberlin sands at 9,226 to 9,240 ft. What made the difference? First, a pre-treatment was run consisting of 15 gal. of Hyflo surfactant mixed with 15 bbl. of oil. This helped lower breakdown pressure and remove any emulsions that may have existed. Then Vis-O-Frac treatment with FL-2 fluid loss additive was run — consisting of 13,000 gal. gelled oil with 10,900 lb. of 20-40 sand tailed-in with 600 lb. of 8-12 sand. Two HT-400 fracturing trucks delivering up to 1,100 hydraulic hp pumped the treating fluid at a rate of 7.5 to 8 bbl. per minute down 2″ EUE tubing. Injection pressure of 6,000 psi dropped to 5,200 psi after the Vis-O-Frac fluid, a true gel, began lowering the friction loss in the treatment.

Waterfrac/Frac-Shot Stops Sand Where Other Attempts Failed

Lincoln County, Oklahoma — Sand returning to the well bore cut out surface fittings on wells in the same zone of a field. Halliburton recommended a Waterfrac treatment tailing in with aluminum pellets, Frac-Shot, thus eliminating the sand problem on this new well. Treatment on the Red Fork gas sand between 3,362 and 3,372 ft. consisted of injecting 20,000 gal. of gelled salt water with 12,000 lb. of 20-40 sand, tailed-in with 1,300 lb. of 10-20 sub-round sand followed by 350 lb. of 8-12 aluminum pellets. Several other wells were fractured using this Waterfrac/Frac-Shot treatment — also with no damaging sand returns. A Twin T-10 and three HT-400 fracturing trucks using an M-45 proportioner injected the treatment.

FRACPLAN Opens Duster For 2,500,000 CFD Gas

Walthall, Mississippi — Logs on a recently completed well showed three dubious production zones in the Good Friday sand of the Lower Tuscaloosa formation near 9,600 ft. Gas would not flare on an initial test and the operator submitted cores for a Halliburton FRACPLAN recommendation. A Waterfrac treatment was performed on the three potential producing sections — two sections three ft. thick and another four ft. section. Treatment consisted of 30,246 gal. of gelled water in three 10,083 gal. stages with Perfpac balls to divert and separate the stages. Propping agent used in each stage was 3,420 lb. of 20-40 sand tailed-in with 615 lb. of aluminum pellets. *Production resulting from this Waterfrac:* 2,500,000 cfd at 2,100 psi with 7 bbl. of condensate per MMCF. Another Waterfrac job using this same FRACPLAN on an offset well gave approximately the same results while similar treatments without the benefit of FRACPLAN on two other offset wells only yielded increases of 750,000 to 1,000,000 cfd.

Multifrac Doubles Oil Yield Over Other Wells

Sweetwater County, Wyoming — A major independent operator owned four wells in the center of a field that all produced about 100% higher than the wells around them after fracturing. The difference — a Vis-O-Frac treatment with higher than usual sand concentration in four stages separated by Perfpac balls was performed on each well. This boosted total production to 3,100 bpd and after four months was still up to 2,500 bpd. These new wells are in Almond Sand of the Mesa Verde formation at 4,645 to 4,681 ft. Vis-O-Frac treatment consisted of 38,000 gal. of gelled diesel oil with 1/20 lb. per gal. of FL-2 low fluid loss additive and 55,000 lb. of 20-40 sand. Three HT-400 pump trucks with an M-45 Proportioner and ball injector performed the treatment.

HALLIBURTON OFFERS A WIDE RANGE of fracturing treatments for you to select the best combination of fluids and propping agents to exactly meet your well's requirements. Call your Halliburton Representative today.

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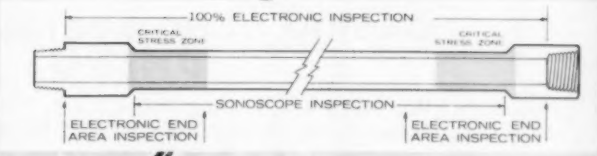

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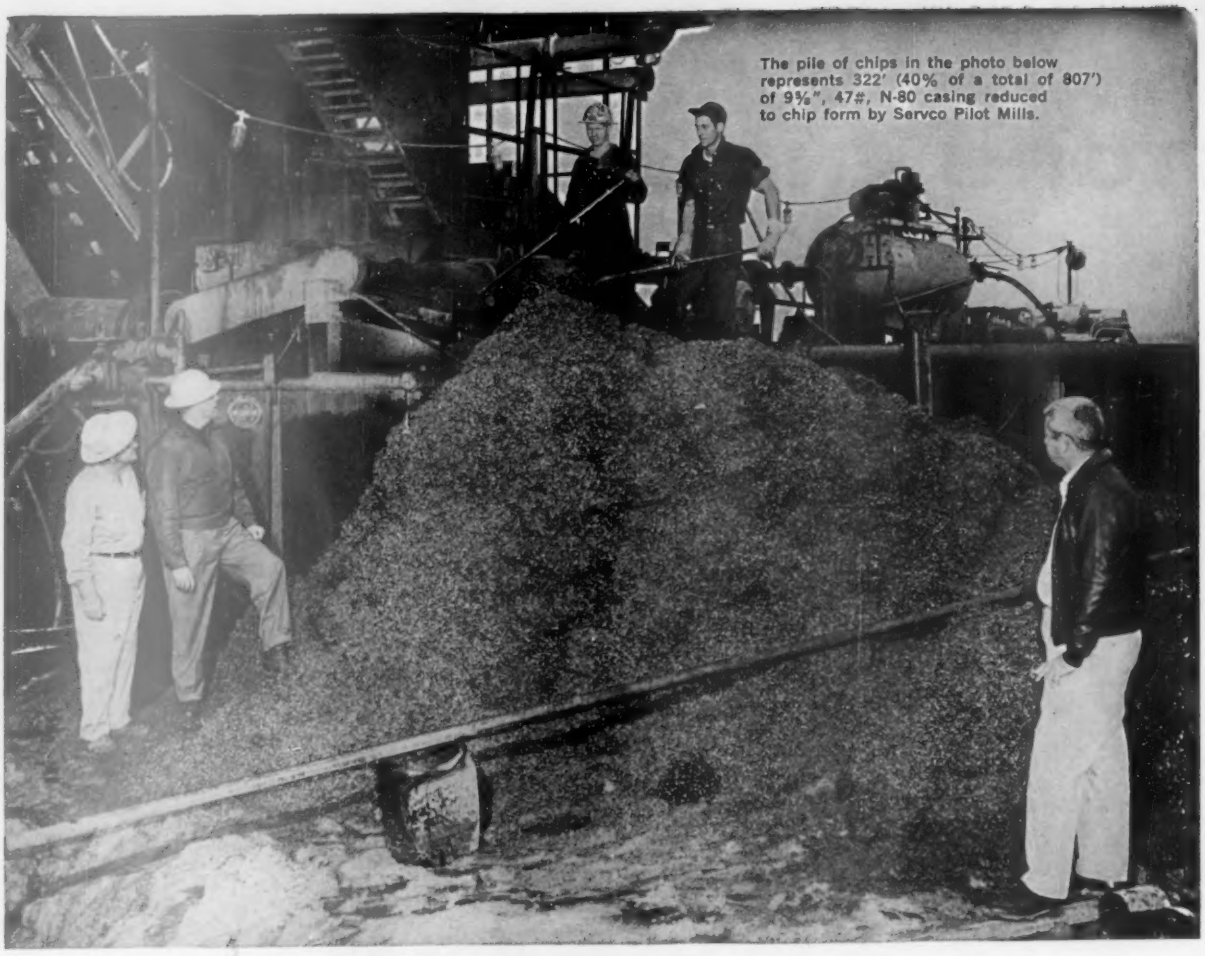

The pile of chips in the photo below represents 322′ (40% of a total of 807′) of 9⅝", 47#, N-80 casing reduced to chip form by Servco Pilot Mills.

Servco Pilot Mills mill 807′ of 9⅝", 47#, N-80 casing at an average rate of 4.6′ per hour!

In running a long string of 9⅝", 47#, N-80 X-line casing, the pipe became stuck at 5862′. Free pipe was recovered to 4139′. Approximately one month's fishing time was then spent in cutting and pulling 700′ of casing. At this point SERVCO was called on the job. *In the next 12 days eleven* SERVCO *Pilot Mills milled 807′ of casing (37,929# of steel), including 4 centralizers and 18 couplings, at an average rate of 4.6′ per hour (216# of steel per hour).*

The Pilot Mills used on this job were dressed with SERVCOLOY "S," SERVCO's unique patented steel cutting carbide material. Their performance is typical of the results SERVCO mills give every day. You can obtain these same results with any of SERVCO's tools—they are revolutionizing down-hole fishing and recompletion work.

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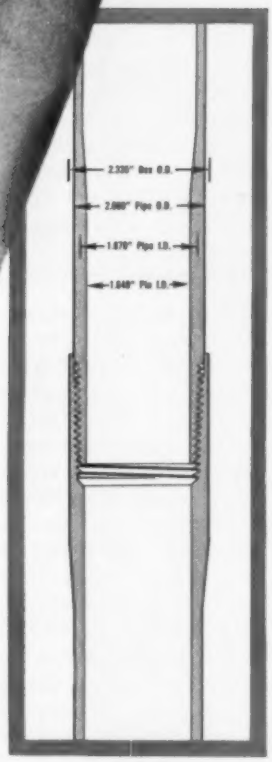

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DRILLING BRIEFS

DRILLING MUD DATA REPORT 61-2

SOLTEX* Reduces Torque, Drag, and Sticking

When introducing our new mud additive a short time back, we talked mostly of SOLTEX's ability to stabilize hole conditions in sloughing shale . . . improving downhole flow properties and fluid loss control, reducing the need for other chemical treatments, and improving oil emulsions. These and other advantages are continuously studied in the lab and successfully verified in the field.

Early in the game, we also realized that SOLTEX might be a natural for reducing torque or drag, and for helping prevent stuck drill pipe. You can't do much with this in the lab . . . so as soon as field testing began, we started taking notes. Sure enough, in well after well SOLTEX did an amazing job of reducing friction and controlling shale. Considerable savings were made possible because of improved hole conditions which resulted in faster penetration rates, rig time saved, and reduced equipment maintenance. Brief accounts on a few of the wells studied are given below.

Sticking and Dragging in Louisiana

While drilling a deviated hole (20°) in Tensas Parish, Louisiana, the bit hit an obstruction at 6,101 feet and stuck. After working the pipe for 6½ hours with no results, the contractor decided to spot oil. While waiting for the pump truck, a treatment of 2½ lbs/bbl of SOLTEX was made over one circulation. Within minutes after the SOLTEX treated mud reached bottom, the pipe came free. No further trouble was encountered.

At a Louisiana Gulf Coast well, the pipe stuck while drilling at 12,400 feet. Three lbs/bbl of SOLTEX were added to the mud, washover operations were started and the fish was recovered with no difficulty.

At one well in South Louisiana, the hole was 8° off vertical and drag was 50-60,000 lbs at 16,180 feet. Five lbs/bbl of SOLTEX were added to the gyp mud over one circulation and drag was practically eliminated. At 16,330 feet, the hole was still drifting but no further drag was experienced.

At another well in the same area, 5 lbs/bbl of SOLTEX were added to control a troublesome shale section which was making it hard to set a whipstock at 7,300 feet. Drag was reduced to less than 10,000 lbs. Three whipstocks were successfully set and hole deviated 30°. The gyp mud used weighed 12.2 lbs/gal.

Tight Hole in West Texas

At 11,780 feet, the hole was off 7½° and drag was 20,000 lbs while pulling off bottom. Slightly over one lb/bbl of SOLTEX was added to a low solids Driscose* mud (11.7 lbs/gal). Torque was reduced and, on the first trip out, drag went down 50%. On previous trips, there appeared to be about 40 feet of fill-up. On the trip after SOLTEX was added, there was none. It is believed that this "fill" was actually friction causing the drill stem to take weight.

Reduce Torque 50% in Oklahoma

At 13,784 feet, 2 lbs/bbl of SOLTEX were added to a 12.8 lbs/gal mud to help stabilize hole conditions. Torque was reduced 50% after the first circulation. Flow properties of the mud improved, pump pressure decreased, and penetration rate improved. A maintenance treatment of 100 lbs of SOLTEX was used on this well during each tour until setting liner at 14,260 feet.

Excessive Friction in California

This well had been sidetracked at 10,000 feet, and hole deviated 23°. Friction had become progressively worse making it necessary to drill in and out of the hole. Approximately 2½ lbs/bbl of SOLTEX were added to the sodium base mud and conditions improved immediately. Treatment was continued as maintenance to final depth and no further trouble was encountered.

• • •

Excessive torque or drag is only one step away from being stuck. Preventative treatments of SOLTEX at the first sign of drag buildup is almost a sure cure that more and more operators are adopting. SOLTEX is usually added in concentrations of from 2 to 6 lbs/bbl, depending upon hole conditions. For more complete information on SOLTEX . . . contact your mud dealer or Drilling Specialties Company representative.

*SOLTEX and Driscose are trademarks for drilling mud additives.

DRILLING SPECIALTIES COMPANY
Bartlesville, Oklahoma

NOWSCO OIL-FIELD MEN OBSOLETE 7 STANDARD WELL PRACTICES ...WITH SPACE-AGE LIQUID NITROGEN TECHNIQUES

NOWSCO men cut your drilling, completion and producing costs with an idea borrowed from missile practice. They pump Liquid Nitrogen to as high as 10,000 psi, then gasify it for servicing wells in many ways. 1700 money, time and trouble saving jobs in the 1½ years since NOWSCO first tested the Liquid Nitrogen idea have well proven the worth of these techniques.

In addition, Nitrogen is eminently practical for purging gathering lines and storage tanks against corrosion or fire hazard. Other profitable uses appear every week. Want the NOWSCO story on your own field conditions? Write today or call our Houston office: UN 4-0965.

NOWSCO offers the only complete Liquid Nitrogen service . . . from manufacture through field application.

NOWSCO service trucks and trained operators who are oil-field veterans are on 24-hour call at stations in Houston, Corpus Christi, Perryton, Orange, Odessa and Lafayette, La.

Originator and prime authority on liquid nitrogen techniques . . .

NOWSCO N_2

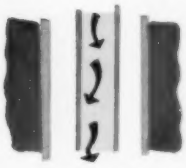
NITROGEN OIL WELL SERVICE COMPANY

3602 West 11th Street, Houston, Texas. Tel: UN 4-0965

Here are 7 standard practices obsoleted by NOWSCO techniques:

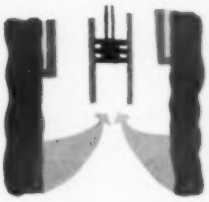
Pressure testing with fluid

Pressure testing for leaks in surface equipment is far more sensitively done with **Nitrogen** than fluid. Gas will detect leaks where high-pressure fluid will not.



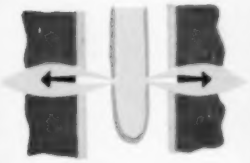
Corrosion inhibitor slugged down tubing

Top-to-bottom "misting" of tubing by nitrified corrosion inhibitor contacts the surface for hours, not minutes. No swabbing-out of fluids. Inhibitor easily squeezed into formation when desired.



Swabbing-in and drill stem testing

Drilling and well fluids displaced by **Nitrogen**, which is then bled off under control to bring in well. Faster, safer than swabbing . . . ends blowouts, swab loss, cable-scarring of plastic tubing lining.



Hydraulic perforating

Co-mingling with **Nitrogen** increases penetration up to 400%. Especially useful in salt water disposal systems, to increase injectability.

Swabbing-out spent frac fluids and acids

Spent frac fluids and acids pushed out of formation with **Nitrogen** bubbles.

Slow chemical lightening of mud density to combat lost circulation

One-trip reduction of mud density with **Nitrogen** bubbles.

Switching from air to mud when drilling near gas

Add **Nitrogen** to air, preventing down-hole explosions. All-**Nitrogen** drilling is often practical.

NOWSCO Nitrogen cuts completion cost — Job #1712

YOU'LL NEVER LOSE ANOTHER SWAB!

(You won't even use one!)

No need for swabbing when NOWSCO brings your well in.

When this Texas offshore wildcat (see diagram) was completed to two gas zones, the contractor took no chances on blowouts or fishing. He called NOWSCO.

Barged out to the drilling rig at 5:30 AM, the NOWSCO serviceman hooked up and had pressure on the lower completion within 15 minutes! Injecting nitrogen at 3500 psi, he displaced all 8900 ft. of lower-string fluid in 1 hour, then displaced 5000 ft. of the upper string in 35 minutes. Well was brought in by controlled bleeding to atmosphere. *Total time — 2½ hours. Total cost — $740!* In addition:

- Gas flow began several hours sooner
- Saved several hours of expensive rig time
- Saved possible scarring of plastic coated tubing by swab cable
- Eliminated possible swab loss
- No chance of blowout

Nitrogen techniques by NOWSCO save money in many other ways — increase penetration of hydraulic perforating, provide inert gas bubbles to push frac fluids and spent acids out of formation, quickly lighten mud column to combat lost circulation, test pressure-tightness more sensitively than with fluid, prevent downhole explosions when gas drilling through pay formations.

NOWSCO Nitrogen comes to your site night or day, in self-contained transport-pump trucks. NOWSCO servicemen are veteran oil field workers thoroughly trained in nitrogen techniques. Backed by more than 1700 cost-saving NOWSCO jobs, they're ready to service your wells with individually calculated injection rates, pressures, volumes.

Want the NOWSCO story on your field conditions? Write or call today for on-the-job case histories.

NOWSCO offers the only complete liquid nitrogen service . . . from manufacture through field application.

NOWSCO service trucks and operators are on 24-hour ready at Houston, Corpus Christi, Perrytown, Odessa, Orange and Lafayette, La.

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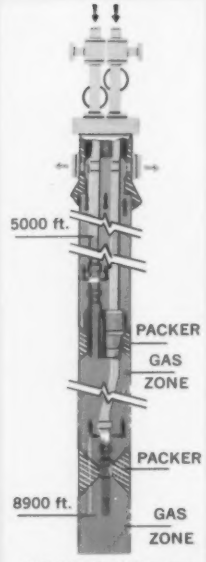

NOWSCO Nitrogen displaced all of lower string and 5000 ft. of upper string, as shown. Both were brought in by bleeding Nitrogen to atmosphere.

QA QA QA QA QA QA

Q. California is still importing oil, isn't it?

A. Yes, and I am afraid it always will.

Q. So this fact alone makes the West Coast a good place to look?

A. That's right. We have refining capacity, rapidly increasing population, demand, and a dwindling supply of oil, so we will probably continue to drill wells even though costs are high.

"Deep gas potential makes Appalachian attractive for years"

H. J. "Red" Magner, vice president and manager, Eastern Operations, Delta Drilling Co., Pittsburgh, Pa.

Q. What is the current situation in the Appalachian area?

A. Oil production is not a big factor up here so far as rotary drilling activity is concerned. A large oil field would be quite valuable, but most of the crude oil is imported from other areas. Natural gas is the big thing in the Appalachian. About 80% of the gas used in this area is imported; only 20% is produced. So, economically, gas is very important and the area is a good potential one for gas exploration.

Q. How does drilling activity there look for the remainder of this year?

A. Fairly good for small rigs but rather slow in comparison to years gone by for deeper drilling. About 30 rotaries are working here now. We consider the Appalachian area to include Pennsylvania, New York, Ohio, West Virginia, Maryland, parts of Virginia down into Tennessee, Kentucky and even up into Canada.

Q. Any estimate of lease activity on the part of major oil companies?

A. Perhaps in excess of 2,000,000 acres are under lease, principally by the major producers who undoubtedly will do considerable evaluation of the area. Prior to the advent of leasing and drilling by such majors as Phillips, Humble, Shell, Gulf, Tidewater, Mobil, Sun and Texaco, development of the area by substantial gas companies and independents had been slow. Reserves were added as needed, to make up any demand differences between pipeline committments and gas available in storage. Local gas reserves are used primarily to balance the supply and demand situation.

Q. What does this mean in terms of drilling activity next year and beyond?

A. Large lease holders coming into this area in recent years will have much evaluation work to do. They will probably be looking for gas reserves... especially at greater depths, which to date have hardly been touched. There are probably no more than 15 wells drilled deeper than 10,000 ft in the basin area from Canada to Alabama.

Q. So, it looks fairly good in the long run?

A. Even if little gas is found in the deep tests, nor a major field discovered at all, it would probably take three or four years to thoroughly evaluate this area.

Q. What are your thoughts on the adequacy or inadequacy of drilling personnel, especially in crews and field supervision?

A. We are declining in general. Provisions haven't been made to give drilling personnel the security or the income necessary for contractors to com-

WHEN YOU ENCOUNTER EXCESSIVE TORQUE, DRAG OR THE HAZARD OF STICKING DRILL PIPE AND CASING....

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92

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excellent dry lubricant • inert • compatible with any mud • mud rheology unaffected • mixes readily • inexpensive • minimum graphitic carbon 92% • durable, weather-resistant 50-lb. bags

SOUTHWESTERN GRAPHITE COMPANY

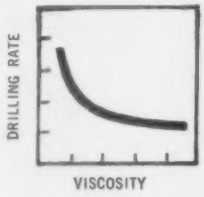
GRAPHITE ROAD • BURNET, TEXAS

4 REASONS WHY MILK EMULSIONS DRILL FASTEST THROUGH HARD ROCK

Milk emulsions have cut time on the hole an average of 38%* on thousands of wells drilled in hard rock areas within the past five years. There are sound technical reasons —

1. No solids build-up — with milk emulsion fluids, low specific gravity solids drop out in the mud pits. Because the cuttings are oil plated they don't hydrate and disintegrate. They don't get pumped back into the well for further grinding with consequent mud weight build-up. Result — faster penetration.

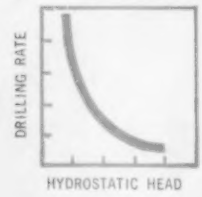
2. Low viscosity — because there is no solids build-up, you operate with low viscosity, low plastic viscosity and low yield point. Therefore, friction losses through the drill pipe and annular space are greatly reduced, and a higher percentage of the horsepower is available at the bit. Result — faster penetration.



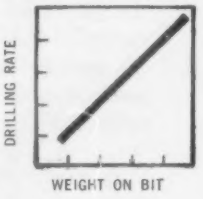
What are Milk Emulsions?

Milk emulsions are low-solids drilling fluids— water containing 5% oil and an emulsifier such as Trimulso, Drilling Milk or Atlosol.

3. Low hydrostatic head — low initial density, the absence of suspended low specific gravity solids and no solids build-up result in a lower hydrostatic head at the bottom of the hole. Result — faster penetration.



4. More weight on the bit — oil-wetting action of the emulsifier lubricates bearings and keeps the bit clean, extending bit life. More weight can be carried on the bit without increasing wear. Result — faster penetration.



In addition to faster penetration, other benefits of using emulsions made with Atlas emulsifier include better geological samples, better hole conditions and lower costs.

*Average of case histories cited in Aquaness Technical Manual on emulsion muds.

Atlas emulsifier is sold through distributors under the following tradenames . . . each is the product of Aquaness Department, Atlas Powder Company:

TRIMULSO® distributed by Baroid Division, National Lead Company.

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DRILLING MILK® distributed by Magnet Cove Barium Corporation.

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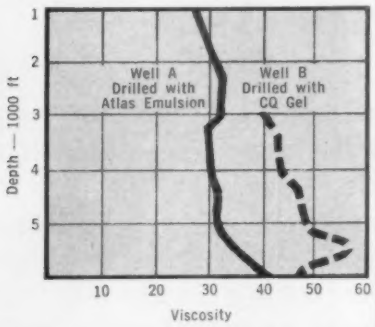
ATLOSOL® distributed by Milwhite Mud Sales Company and other selected mud companies.

Registered trademark Atlas Powder Company.

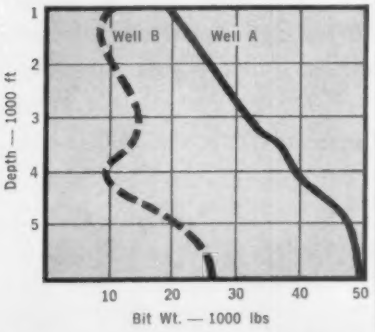
Aquaness
DEPARTMENT
ATLAS CHEMICAL INDUSTRIES, INC

Atlas Emulsifier DOUBLES Penetration Rate On Wyoming Well

Faster drilling with an Atlas emulsion on a Big Horn Basin well in Big Horn County, Wyoming, cut rig time by 12½ days... penetration averaged 25.3 ft/hr compared with 12.8 ft/hr for an offset well. Typical of milk emulsion drilled wells, more weight was carried on the bit. Oil wetting provided better lubrication and extended bit life . . . 13 fewer bits were used. The Atlas emulsion used on Well A showed no solids build-up — viscosity remained virtually unchanged to TD. Acclaimed as the best-drilled well in the area to date, both contractor and operator attribute improved performance to the use of an Atlas milk emulsion. The



low-solids, low-viscosity, low water-loss emulsion maintained a trouble-free open hole and brought up clean cuttings that dropped out fast in the pits. Savings in rig time and bit costs for the 5400-foot comparison interval totaled $16,333.



Ask the Aquaness drilling specialist for complete information on all the benefits of Atlas milk emulsion drilling. His case histories show how Atlas milk emulsions have contributed to better wells, drilled faster with substantial savings in over-all costs.

pete for similar positioned men in other industries. A roughneck or driller who has to move about considerably will wind up at the end of the year with less money than if he had a rather menial job in a factory where he could stay in one spot.

Q. As a manager, what are your thoughts regarding pay, work schedules, training and fringe benefits for the crews?

A. It is almost essential that we have improvements in all of these if we are going to progress. Our equipment and techniques are becoming more complicated, which creates a demand for higher skills in crew members.

Q. Is there any trend in your area toward these programs?

A. Presently, no. The trend is toward static pay because of the strong competitive nature of our business here.

Q. Is there any indication of efforts by unions to organize drilling crews in the Appalachian area?

A. Not at the moment.

Q. Have you noticed any differences in recent years in the contractor-operator relationship?

A. No, I haven't noticed too much difference. The companies for whom we work have been very considerate, and they are not opposed to the idea that a contractor should be making a profit.

Q. Do you have any ideas or thoughts about improvement in the relationship you now have to the benefit of both parties?

A. We have enjoyed a rather different position up here. The contractor is usually involved in the decision making on the progress of the well, the casing program and other aspects. We actually get into partial engineering of the hole, mainly because the operators do not have rotary personnel in abundance and they are also unfamiliar with our air drilling. The contractor is highly regarded, more than just a service company.

Q. Is there any turnkey contracting or trend toward such going on in the Appalachian area that you know of?

A. Some. Most of the companies like to complete the wells as they see fit and the major portion of the hole is contracted by the foot anyway. The completions or turnkey aspects of it are basically minor. Turnkey work is done mostly for independents who have no operating staff.

Q. What in your opinion as a manager is a reasonable return for contract drilling, that is, what percentage should net profit be of footage and daywork charges?

A. I would say about 15% above overhead, depreciation and actual well costs.

Q. Do you think very many contractors are getting this reasonable return today?

A. I don't think so.

Q. Is there any practical answer to the critical problem of underbidding?

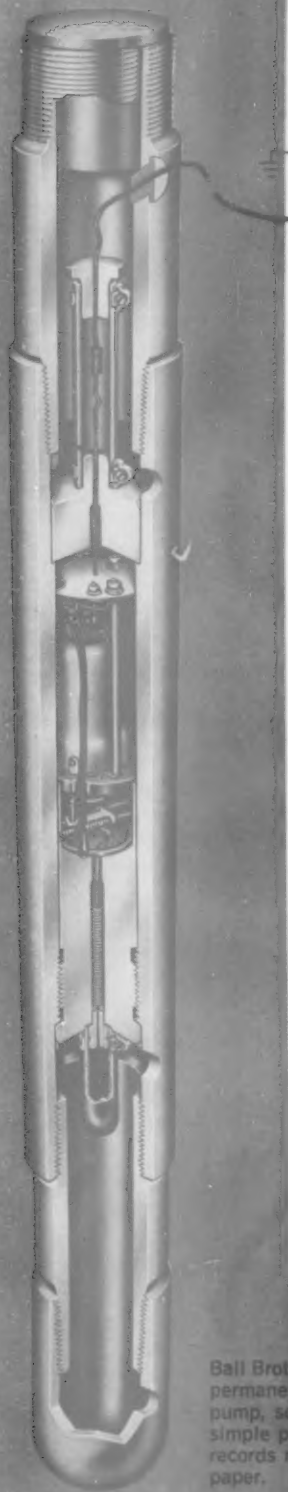
A. I don't think there is. Unfortunately, if you have two rigs side by side, available for one location, and one or both contractors need to generate cash or try to maintain his organization, the bid will go at a low rate.

Q. What are some of the average costs per foot to drill a well

with

Ball

Bottom-Hole Pressure Gauge



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The **Pressure Sentry MK-7** is permanently installed below the pump. Digital signals from a Bourdon tube-coded disk assembly are sent up a single conductor wire to assure a ±1% pressure readout accuracy. The MK-7 gives you the advantage of immediate pressures from pumping, flowing or shut-in wells. Our instrument provides complete, continuous reservoir pressure records for secondary recovery operations.

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Service

Simple installation can be performed by your pulling crew. However, Ball Brothers' experienced oil field engineers are available for complete engineering and installation assistance. Our service policy provides for exchange of the subsurface unit at a reasonable cost.

Ball Brothers Pressure Sentry MK-7, permanently installed below the pump, sends digital signals to the simple portable surface unit which records reservoir pressure on chart paper.

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Pressure Sentry MK-7 Features

VERSATILE

The MK-7 may be used in 4½" and larger casing. Pressure ranges to 8000 psi are available. The gauge will operate in wells with temperatures to 275° F. An auxiliary timer unit is available to automatically record pressures at predetermined intervals.

ACCURATE

Readout is not influenced by absolute value of current or resistance of wire.

CONVENIENT TO USE

Just attach the portable recorder unit to the wellhead connection and turn on recorder.

SIMPLE TO OPERATE

Non-technical personnel may take pressure readings while doing normal routine work.

PERMANENT RECORD

Pressure readings on chart may be kept as a permanent record.

ECONOMICAL

Downtime is not incurred while taking pressures. Pressures can be taken with the well flowing or pumping. One surface unit can serve many bottom-hole units.

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Shut-in buildup time on productivity indices is reduced by instant knowledge of the pressure plateau.

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QA QA QA QA QA QA

in your area, realizing there are different depths in different places? This does not include completion, just the basic drilling cost.

A. In those areas where deviation isn't a great problem, a 7000-ft well could be contracted for approximately $5 to $7 per ft. In areas where deviation is a factor, the rate will run in the neighborhood of $6 to $8 per ft. On remote wildcats, deeper (10,000 ft) drilling or sometimes in the areas where you get 40 to 60-deg formation dips, day work contracts are common.

Q. Is our conventional surface rotary drilling equipment as we know it today becoming obsolete in view of economic pressures and new downhole drilling techniques?

A. I wouldn't say that it is, unless you completely change the entire concept of rotary drilling. Air drilling partially has done this in the Appalachians. The importance, for instance, of a pump is not significant because we drill 95% of our hole with air. Importance of the drawworks is reduced and its efficiency is not a requisite because we make so few trips. The key to drilling up here is a good downhole system... that is, good collars, drill pipe, compressors and bits.

Q. Surface equipment is somewhat secondary then?

A. That's right, but we are extending the useful life of surface equipment. It is immaterial to us whether we have a 15-year old traveling block or two-year old traveling block. The efficiency of only two or three trips on a 7500-ft well has little effect on the overall cost of the well. On surface drilling equipment, it is important to unitize and streamline for rig moves.

Q. Which item of drilling equipment needs improving?

A. I would say the rig power. The gas turbine engine holds considerable promise, whether it is used as a direct power to the drawworks, etc. or whether it is used to power electric generators.

Q. Speaking of the drilling methods, what are some of the most promising techniques in your area?

A. Improvement in air, airfoam and gas techniques. No one drills up here without air or gas equipment. There are only a few mud-drilled holes in the entire Appalachian basin.

Q. What determines whether you use air or mud?

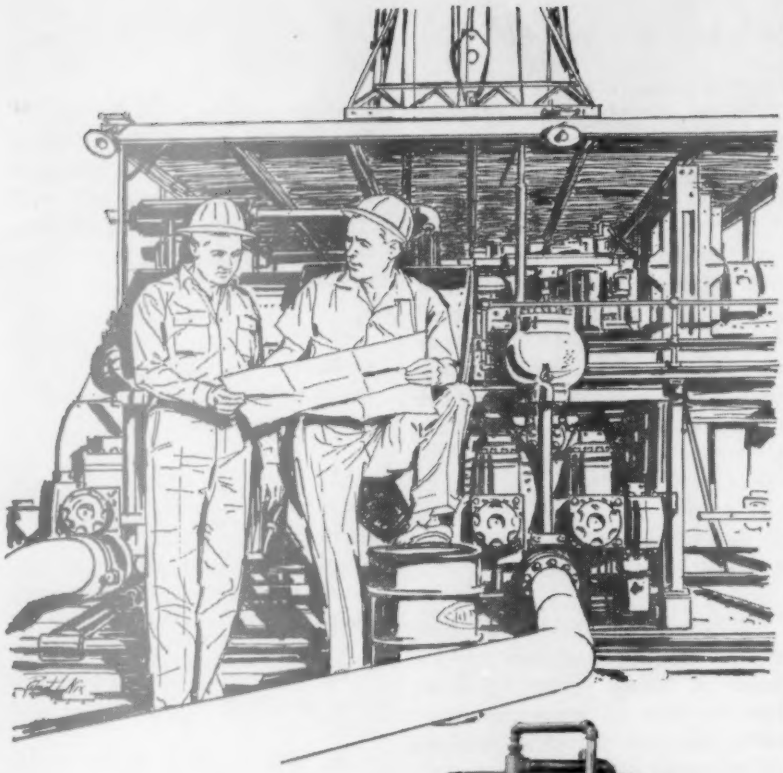
A. We adopt a different approach compared to Southwest practices. We go on every hole with the idea of drilling as much of it with air or gas as we can, then drill with fluid only when necessary.

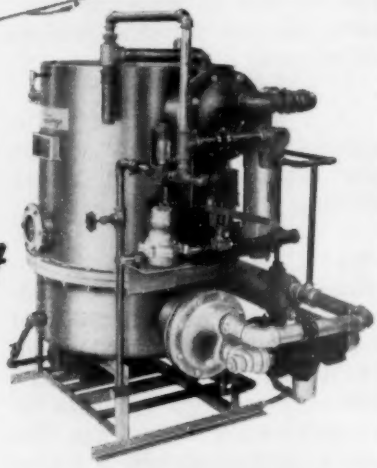
Q. What determines whether you use air or gas?

A. In general, we use air because gas is such an expensive commodity. The only time we use gas is from the safety standpoint such as when drilling through a producing horizon.

Q. What has been the most significant development in downhole tools in the past year or two up there?

A. Many are familiar with the hammer drill and it has a place in certain spots. It is not run on every hole, but in places where there are tough formations, on the surface or at depth, the hammer drill has proved to be quite economical. It is also good in deviation sections where bit weight is reduced. The air motor drill holds promise but needs to be perfected.





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For further details write Dept. P for this new Aquavap Bulletin.

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QA QA QA QA QA QA

Q. Is slimhole drilling much of a factor up there?

A. No. Our observation in air drilling is that if we duplicate in a large hole the conditions that exist in a 6¾-in. hole, (that is, have the same weight per in. of bit diameter, the same return velocity of air and the same pressure), we can drill a larger hole just as quickly as a small one. A small hole has a tendency to restrict the air return, thereby building up back-pressure which reduces the air volume and actually slows the operation down. We find that 7⅞-in. or 8¾-in. holes are the most economic in air drilling.

Q. Have you noticed any trend toward multiple completions in the Appalachian?

A. If we are drilling all the way through with gas, it is just as easy to drill all zones, set pipe and produce from these multiple horizons through one bore. The practice of setting multiple tubing strings isn't used.

"Industry's economy drive has boosted air/gas drilling"

Robert W. Sneed, vice president, Well Completions, Inc., Denver, Colo.

Q. In what areas do you operate?

A. We operate in all Rocky Mountain and Mid-Continent states as well as California and Canada. Our principal area of operations is the Rocky Mountain region.

Q. How has activity been so far this year?

A. We are having an excellent year with almost all of our equipment in constant use.

QA QA QA QA QA QA

Q. What kind of equipment do you have?

A. We are an air drilling service engineering company, offering technical supervision of air drilling jobs in conjunction with our compressor and booster equipment. Additionally, we have a variety of auxiliary pumps and tools, chemicals and services associated with air and gas drilling. Most of our compressor and compressor booster service units are trailer mounted.

Q. Has 1961 been a good year so far?

A. Yes. Considerably aided by the industry's drive for economy in drilling operations, we have been able to keep a high percentage of our equipment busy.

Q. Does air and gas drilling seem to be catching on in new areas?

A. We are receiving more inquiries than in the previous years for technical data from areas outside of our service area.

Q. Have you explored new areas?

A. We are directing our expansion attentions overseas, having formed AIRDRILL International, Inc., in early 1960 for this purpose. We have provided feasibility studies and technical supervision for a number of national and private oil companies.

Q. Have you had occasions to air drill from top to bottom?

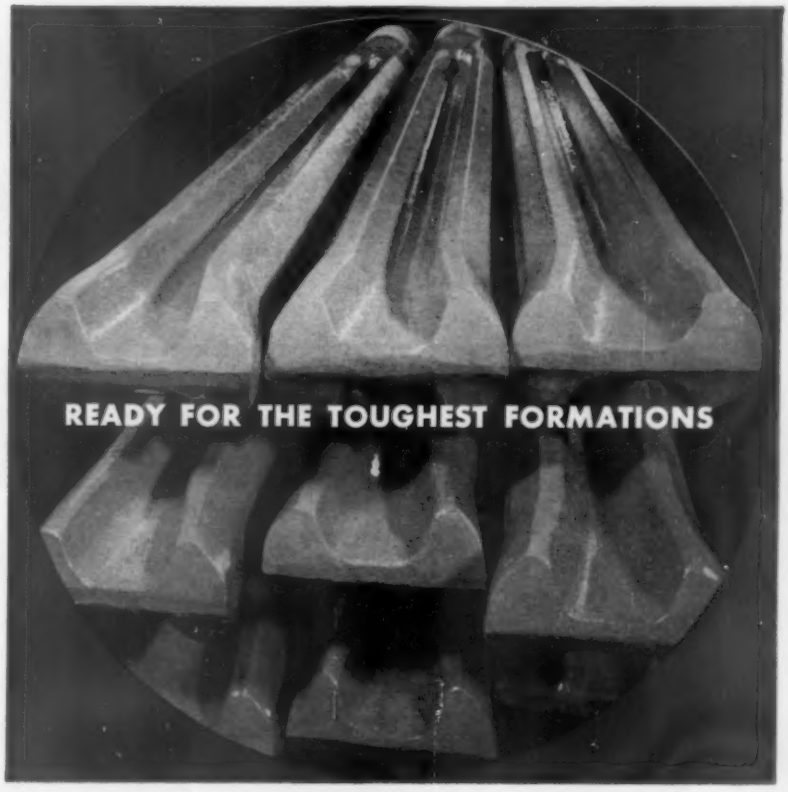
A. Quite a few hundred, I'd say.

Q. Do you find that air drilling can be used for most of total depth?

A. Yes. We made a survey two years ago in which we analyzed all of our air drilling jobs for the previous 18-month period, a total of almost half a million feet of hole. It showed that 86% of all wells started with air reached projected depth with air techniques. This percentage figure is still valid today.

Q. Is it true that air drilling lends itself to certain areas where there is an absence of water?

A. This is, of course, the ideal condition. We have come a long way in technical developments to overcome water influx, even in large quantities. Air drilling can lend itself to cost savings for many reasons beyond dry formations. Thanks to air drilling through a lost circulation zone, one of our foreign clients, for instance, collected samples for lithologic analysis which pre-



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What's the difference? PROVEN PERFORMANCE . . . in more footage . . . fewer dressings . . . less rig down time! That's the record of SPANGALOY bits after months of field tests conducted under the toughest drilling conditions.

SPANGALOY bits are made of a special alloy. This, plus improved heat treatment, results in greater tensile strength and yield to withstand the torque, impact, vibration and abrasion encountered in the hardest and most irregular formations.

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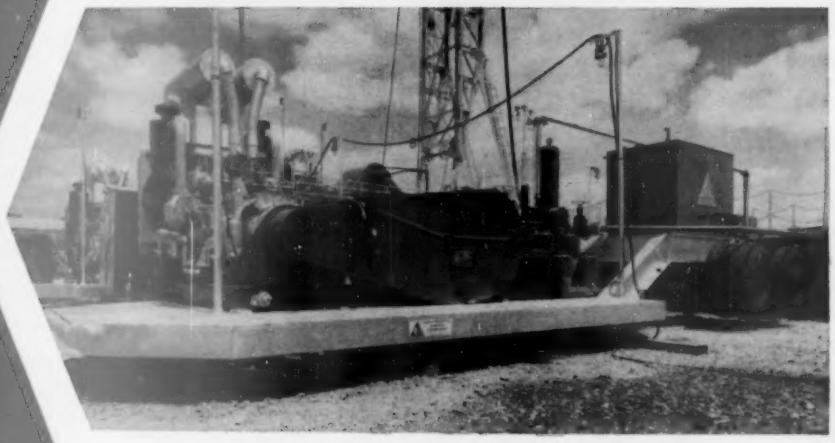
WANT TO MOVE SLUSH PUMPS EASIER?



CONTINENTAL HAS THE ANSWER.. *Worldwide!*

Continental's seven slush pump models can be trailerized for contractors who want to move fast. New or old pumps can be mounted on custom-built trailers for special rigs or on standard trailers. Either way, you'll be able to reduce slush pump rig-up and tear-down time from your bids. Ask your Continental man about the reasonable cost of trailerizing these pumps.

CONTINENTAL EMSCO

CONTINENTAL-EMSCO COMPANY, a Division of The Youngstown Sheet and Tube Company
General Offices: Dallas, Texas
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6P11-31

viously had never been obtained with mud.

Q. What is an average rental fee for air and gas equipment to drill a 5000 to 8000-ft well using 4½-in. drill pipe in 7⅞-in. hole?

A. About $450 per day for engineering service and equipment in a hole of that size. We maintain and operate our own equipment and provide supervisors and personnel. We can also provide manifolding and piping, all chemical injection equipment — in effect everything associated with air drilling.

Q. Is there a tendency on the part of the operators to accept air and gas drilling more readily now than in the past?

A. Acceptance has generally improved.

Q. Do they have any fears or reservations about considering air and gas drilling?

A. Yes. Safety is one factor. Reservations about using air or gas may be related to familiarity with the technique, distance from a fully equipped service point, and the quantity of information available on the job being analyzed for air and gas application.

Q. Is your contract with the drilling contractor or with the operator?

A. Usually with the operator. The contractor is on day work.

Q. What is your relationship with the contractor and the operator when your people are on the job?

A. Generally speaking, we are hired by the operator and we report to him. Like the drilling contractor, we are using our experience, skills and equipment to achieve maximum performance for the operator.

Q. What have been some of the most significant developments in air and gas drilling in recent years?

A. Mist drilling — injecting foaming agents into the air and gas stream in solution — has been significant.

Q. What rates of water flow can be handled with the use of these surfactants?

A. How much water can be handled is limited only by the horsepower available and lithologic conditions.

Q. What is the relationship between the amount of water removed and the amount of surfactant injected into the airstream?

A. Chemical and physical properties of the invading water affect the type of surfactant used ... as do lithology of the open hole, size of hole and penetration rate. An initial foaming agent injection rate of 0.2 of 1% of the produced and injected water is altered as hole conditions dictate.

Q. What seems to be the best combination of hole size and drill pipe size for air drilling?

A. Considering air costs only, probably a 7⅞-in. hole and 3½-in. OD drill pipe.

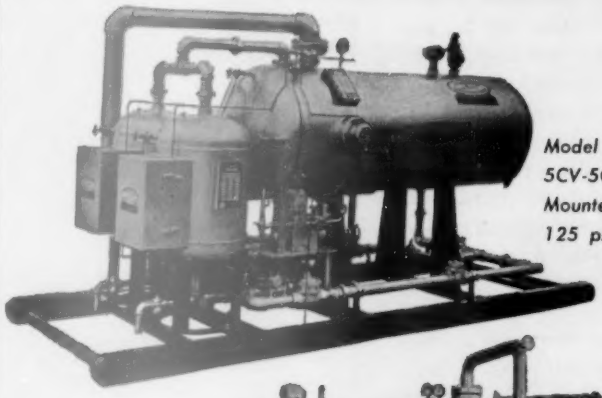
Q. Do you have any problem using air to drill into productive zones?

A. No.

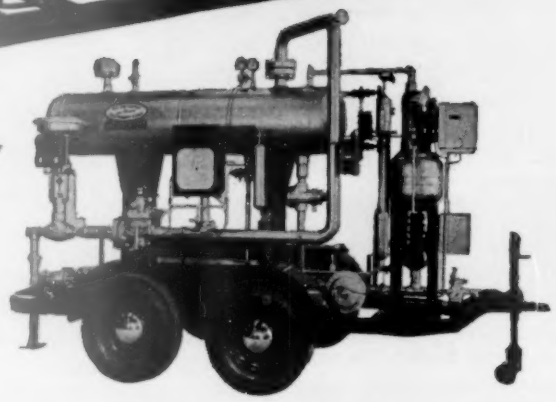
Q. Is there any difference between the hazard of air drilling gas or oil zones?

A. Air drilling presents no particular hazard in an oil zone as opposed to a gas zone. Our experience indicates that gas

METROL® Well Testers®



Model 30WT-0106S-5CV-5CV Skid Mounted Well Tester, 125 psi W.P.



Model 20WT-1407 2½FV Trailer Mounted Well Tester, 1440 psi W.P.

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METROL Well Testers are oil and gas separators with oil, gas and/or water meters piped on them for separating and measuring production from oil and gas wells. Sizes available are 16, 24, 30, 36, 48, 60, and 72-inch diameter with 6' to 20' shell lengths in 125, 300, 600, 1200, 1500, 2000, 2400, and 3000 psi. W.P. These units will handle from zero to 20,000 BPD.

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QA QA QA QA QA QA

companies are more prone to use air as a drilling-in medium than oil companies, and as a result, a great many more gas wells have been drilled-in with air.

Q. Would the idea of mist drilling overcome the reluctance to use air when drilling into or through oil zones?

A. Mist drilling has been influential in overcoming this reluctance. We expect even less reluctance when improvements have been made in the oil foamers currently available.

Q. Have there been any serious downhole explosions recently?

A. There have never been any downhole explosions while air drilling, to my knowledge. There have been some downhole fires, but never explosions.

Q. How do you make a distinction?

A. A fire is combustion without the presence of detonation or a shock wave.

Q. As opposed to mud, what are the principal differences in the safety precautions on surface hookups when drilling with air or gas?

A. There are numerous differences, but principally the rotating blowout preventer that packs off around the kelly. Any gases encountered are safely exhausted through the flow line and ignited.

Q. Have you experimented with rotating gas where you separate the dust cuttings from the return gas?

A. We have been working with a closed system for a number of years. Cuttings can be removed from the exhaust stream and clean gas recirculated down the hole again after repressur-

Lloyd Curry, Houston store pump repair man, running vacuum machine leak test on ball and seat

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The biggest single item that goes into a pump repaired at your Wilson store is *service*. As you would expect, the pump repair men at Wilson Supply have the proper testing equipment, complete spare parts inventories and know-how to repair your sub-surface pumps *properly* and *promptly*.

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QA QA QA QA QA QA

ing. Excess gas found while drilling can be flared, but preferably returned to a gathering system for sale.

Q. What is the difference in procedure, if any, when you are drilling in with air for a gas well?

A. No major difference than when drilling-in for oil. We maintain a small flare on the end of the blooie line which ignites natural gas produced by the well.

Q. Are there any compressor developments that look interesting to you?

A. The turbine-driven high-speed centrifugal compressor looks as if it might have promise, once capital cost and operating costs can be brought into line. Although there are still a great many jack-hammer type compressors being offered for air drilling purposes, more and more emphasis is being placed on larger, more efficient, double-acting compressor packages.

Q. Do you find that the present conventional drill strings are well suited to air and gas drilling?

A. Generally speaking, yes. We do have a dual passage drill pipe system in use as well. By using a dual passage drill pipe we reduce the amount of air volume necessary to ensure velocities for cuttings removal. There is no circulation in the hole annulus except at the bit face. A specially designed dual passage bit directs return circulation back up the central annulus.

Q. Do you use diamond bits in air and gas drilling?

A. A great many wells are cored with diamond core heads using air, but diamond bits are seldom used in conventional air and gas drilling. The hard formation type rock bit has proven satisfactory.

Q. Is closer consideration given to rotary speed and bit weights when using air and gas in general?

A. Generally, the rotary table is turned much slower . . . preferably not exceeding 80 rpm. Light bit weights are the rule in air and gas drilling.

Q. Is there any rule-of-thumb on annular velocities for air and gas drilling?

A. In our pre-well planning with operators, we recommend 4500 ft per min annular velocity rise. This available capacity on location allows us to handle adverse conditions when encountered, and without delay. This same capacity under dry drilling conditions should achieve optimum penetration rates.

Editor's Note:

Two of the contractors originally included in this group of interviews were George B. Kitchel, vice president of Kerr-McGee Oil Industries, Inc., Houston, Tex., who handles Kermac's offshore drilling activities, and Walter Kalteyer, vice president and general manager for Hunt Drilling Co. at Corpus Christi, Tex., which operates five rotary rigs along the Texas Gulf Coast and in the Southwest Texas area.

Hurricane Carla, perhaps the most devastating freak of nature ever to hit the Gulf Coast in modern times, drastically affected the operations of both Kerr-McGee and Hunt Drilling Co. Both Mr. Kitchel and Mr. Kalteyer were given a chance to review their completed interviews, but due to the interruption of communications and their obligation to critical operating problems as a result of the hurricane, they were unable to return the interviews before press time.

Therefore, their comments are not included here, but will appear in the November issue. We hope damage to drilling rigs in these two areas was nominal. ■

AAODC Presents Outstanding Speakers

Delegates to the 21st Annual Meeting of the American Association of Oil Well Drilling Contractors will hear papers presented by an outstanding roster of speakers. Principal speakers at the meeting, being held October 4-6 at the Rice Hotel, Houston, include:

John J. Moran, AAODC president and chairman of the board of Moran Bros., Inc., will address the Thursday afternoon session.

Minor S. Jameson, Jr., executive vice president of IPAA, will speak before the Thursday afternoon session.

L. L. Payne, Henry B. Woods and R. S. Grant, members of the engineering department of Hughes Tool Co., are authors of a paper, "Recent Trends in Rotary Drilling Methods," which will be presented at the Thursday session.

Speaker at the Thursday evening banquet will be Dr. Fred Schwarz, president of the Christian Anti-Communism Crusade, Long Beach, California.

Dr. Thad Vreeland, Jr., associate professor of mechanical engineering at the California Institute of Technology, Pasadena, will speak at the Friday morning session on "Deformation of Drill Pipe in Rotary Slips."

Fred Chisholm, R. W. Ruhe, and William J. Murchison, staff member of Magnet Cove Barium Corp., Houston, are authors of the paper "Good Drilling Mud Practice is Not by Accident" which will be presented at the Friday morning session.

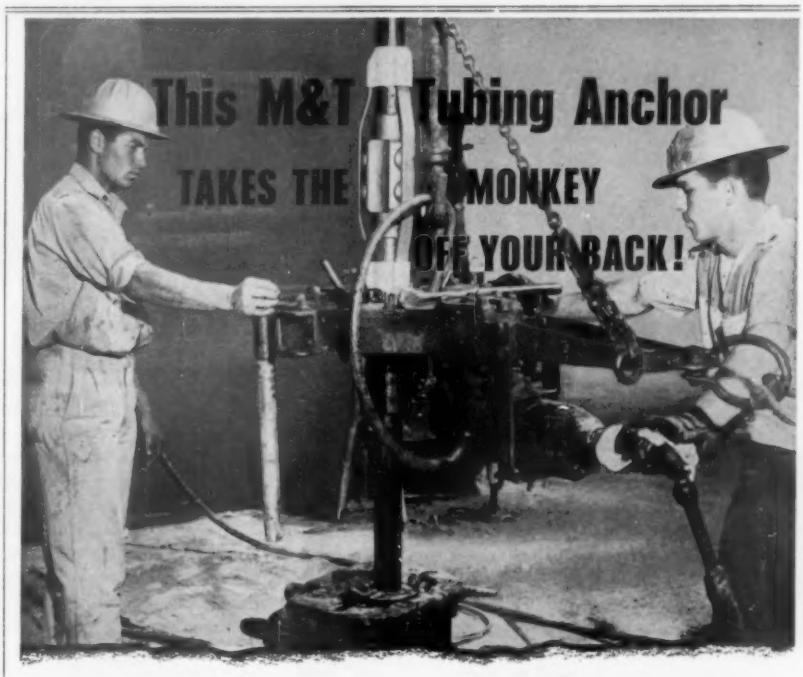
William P. Clements, Jr., president of The Southeastern Drilling Corp., Dallas, will speak on "Sound Contracting Practices" at the Friday morning meeting.

Dr. Bruce C. Netschert will discuss "Technology and the Future of Oil and Gas" at the Friday morning session. He is director of the Washington office, National Economic Research Associates, Inc.

Louie E. Throgmorton, vice president and director of public services of the Republic National Life Insurance Co., Dallas, will speak at the Friday luncheon.

The meeting will also be highlighted by various committee meetings on Wednesday and Thursday mornings. The 1961 Board of Directors will meet on Wednesday afternoon.

A hospitality hour for delegates and their ladies will be held on Wednesday evening. Many other functions have been planned for the ladies attending the meeting.



What does that mean? It means you've got more time for other duties, because the M&T Compensating Frictional Tubing Anchor can be run by your own crew without your supervision.

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H'm. How do you get it out again? No trouble there, either. Unseating the pump releases the M&T Anchor. You can move it or pull it at any time, under any conditions . . . wet or dry . . . no bleeder valve needed . . . no risk of a costly fishing job.

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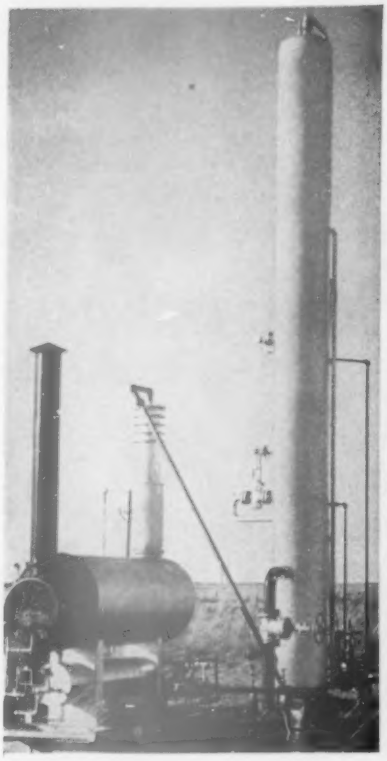
New Process Solves Gas and Condensate Co-mingling Problems



Maloney-Crawford's new Duo-Dry process eliminates the need for separate lines to carry your gas and condensate from the well to central facilities. It can accomplish this even when line heaters have not been satisfactory. In the Duo-Dry process, a single contactor vessel dehydrates gas, then uses this under-saturated gas to strip solution water from condensate. The gas then is dehydrated in the usual manner. The dehydrated gas and condensate can be recombined in the same pipeline without the danger of downstream freezing. It is a trouble free process using only proven contact methods. No untried desiccants. The savings can be large for isolated wells, especially those in colder climates, and offshore locations. Don't lay an expensive second line without investigating this low-cost alternative. Get the details today.

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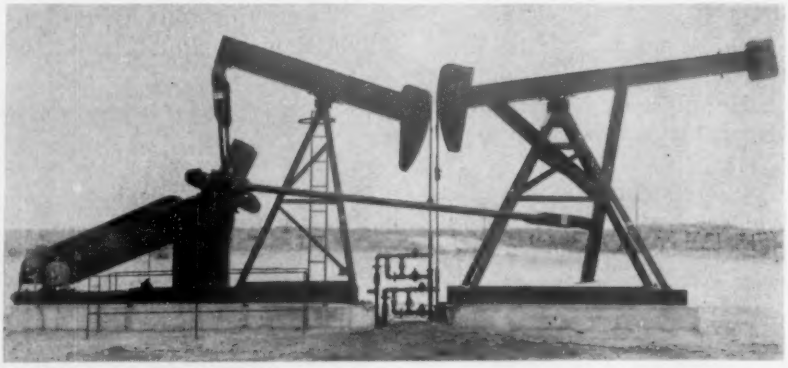
D & P Equipment

Unique Dual Completion Pump



To pump dual completions for less money, the "Siamese Dual" pumping unit has been introduced. A "slave" or secondary unit is attached to an API primary unit at the latter's larger wrist pin assembly — through which the former receives its power without reducer and cranks. Peak torque required by both units combined is normally only 10% more than for one unit alone. The secondary unit may be adjusted easily to other stroke lengths without affecting stroke length of the primary. In some instances, the secondary can be made to stroke greater than the primary. By stroke adjustment and pump size, fluid delivered to the surface may be controlled. Because the two units are individually balanced easily by one man it is possible to "knock off" the secondary, and the primary will continue in balance. If the zone of the secondary unit is depleted first, only disconnection of the secondary unit is required. If the primary unit zone is depleted first, you can easily disconnect the secondary unit and slide the primary forward the distance of the well centers to deplete the secondary unit zone. *American Manufacturing Co. of Texas.*

Circle number (1) on reply card.

High-Pressure Plug Injector

A Kinney plug injector with a pressure capacity of 5000 lb has been developed to meet a demand for better equipment to scrape paraffin and sand from high-pressure oil field flowlines. It permits the use of either a soluble asphalt-base plug or a non-soluable, brush-type "pig" to clear accumulations from interior walls. It is designed with rubber seat sealing elements to seal in high-pressure gas and distillate service. *Alco Products, Inc.*

Circle number (2) on reply card.

Liquid Level Transmitter

Combining accuracy of mechanical measuring and efficiency of electronic signaling, a liquid level transmitter has been introduced with fittings to adapt it to all types of liquid-containing vessels. It can be mounted in left or right-hand position and is reversible in the field. It transmits d-c signals proportional to level variations and is readily adaptable to all systems using electronic indicators, recorders or controllers. It features: LVTD displacement transducer coupled with amplifier with solid state circuitry; high feedback; and explosion-proof instrument case. *Mason-Neilan.*

Circle number (3) on reply card.

For Corrosive Services

Combination of type 316 stainless steel and Teflon seats is said to provide a new precision-constructed ball valve with superior corrosion resistance and life expectancy. It is avail-

able in ¼ to 2-in. sizes and features: top-entry design; self-aligning ball; straight-through flow; quarter-turn operation; low-operating torque; and leak-proof performance. Its design and manufacture to extremely close tolerances is said to eliminate need for adjustment or take-up maintenance while in service. Internal springs or compensators to counteract wear at the most critical points are not needed. Temperature range is from minus 20 F to plus 400 F with Teflon seats and from minus 20 F to plus 220 F with Buna-N seats. *The Lunkenheimer Co.*

Circle number (4) on reply card.

"Delrin" Pipe In New Sizes

"Delrin" acetal resin pipe is now available in three new sizes — a 3-in., as well as a 2-in. and 1½-in. that have greater wall thicknesses and improved psi ratings over the 2-in. and 1½-in. already introduced. The newest 2-in. has wall thickness of .200 in. and rating of 500 psi, while the newest 1½-in. has wall thickness of .160 in. and rating of 500 psi. Wall thickness of the 3-in. is .100 and rating is 175 psi. (All thicknesses are at 70 F.) Applications include flowlines, as well as gathering, waterflood and salt water disposal lines. *E. I. du Pont de Nemours & Co.*

Circle number (5) on reply card.

Liquid Level Control Pilots

Available with either snap or throttling action and with or without a relay is a series of economy liquid level control pilots designed for oil production work. Used with any Fisher displacer, they control liquid level in separators, tanks, knockout drums, heater treaters, etc. The snap-acting pilots, providing on-off control, are normally used where sand or other impurities entrained in crude oil cause rapid wearing of trim parts on throttling type valves. The throttling pilot is normally used when flow is being metered or on less severe operating conditions. These pilots have a filter-regulator in the supply inlet that permits use of wet natural gas for operating medium. The series includes: snap-acting pilots Type 2511 (without relay) and Type 2512 (with relay); and throttling pilots Type 2513 (without relay) and Type 2514 (with relay). *Fisher Governor Co.*

Circle number (6) on reply card.

Hydrogen Sulfide Test Kit

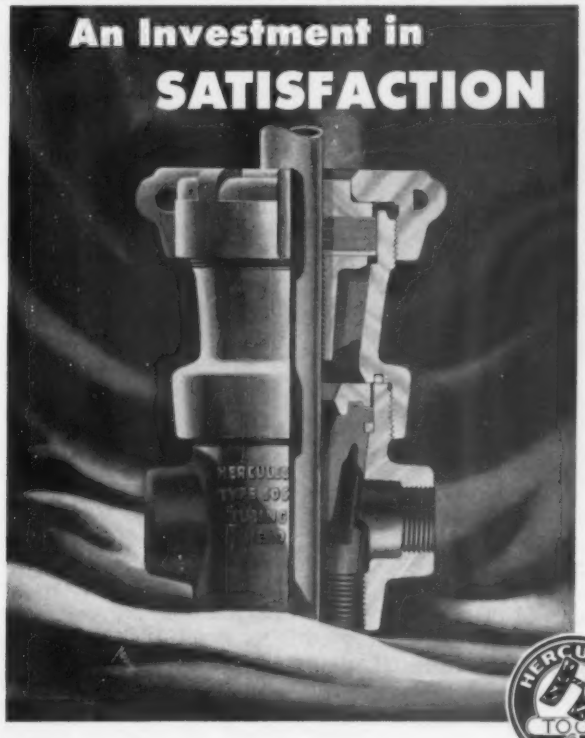
To permit testing for hydrogen sulfide in water and oilfield brines, a simple and compact kit is now available. It accurately measures hydrogen sulfide in steps of 0.5 ppm in concentrations from 0.5 ppm and more. Presence of hydrogen sulfide can be conducted in 1 min. Weighing only 5 oz, the kit is packed in a pocket-size, clear plastic box 4⅜ in. by 2⅝ in. by 1 in. Fifty tests can be performed on water averaging 3 ppm hydrogen sulfide with reagents in the kit. *Hagan Chemicals & Controls Inc.*

Circle number (7) on reply card.

Controls Powder-Fluid Mixing

Mo-Jet is a unit designed for mixing dry powders or flake materials with fluids. Designed to handle certain types of powders or materials that hydrate almost instantaneously on contact with the carrying fluid, the unit controls amount of product mixed. The unit also performs efficiently in mixing two fluids and provides uniform entrainment. It operates on a venturi principle and is self-cleaning. *Brine Service Co. Inc.*

Circle number (8) on reply card.



In the production of oil, you need, want and should have the best available. Hercules equipment fulfills these requirements having been designed, machined and field-tested to do a specific job better. The same high standards of production are always maintained; but that is not all. Research is employed to ascertain the changing needs of the Oil Industry and to be certain Hercules products fulfill these requirements, every item in the line must first meet our own exacting standards, assuring you maximum safety of operation, long life and economy.

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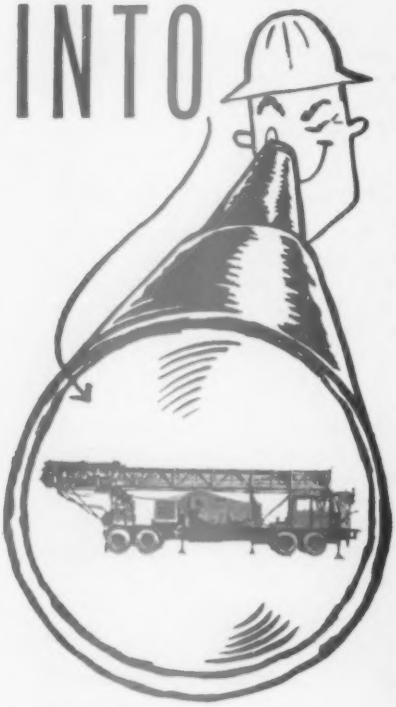

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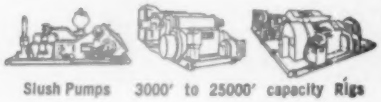
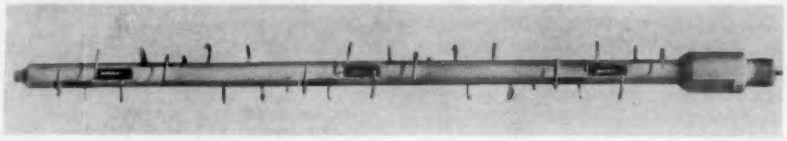


Slush Pumps 3000′ to 25000′ capacity Rigs

Flowing Well Paraffin Scraper



A new style paraffin scraper has been designed to be run on either a measuring line or a well-servicing sand line. The tool consists of identical spring scrapers, precision-staggered on a mandrel so that the tubing's internal wall will be completely stripped of all paraffin. Since the heat-treated mandrel is not subject to appreciable wear, scraper springs are the only parts required for redressing the tool. The springs are easily replaced by unlocking and removing the steel bar that runs through the hollow mandrel. *Equipment Engineers, Inc.*

Circle number (9) on reply card.

For Underwater Surveying

Depth of the ocean floor can be accurately measured with new Model 220 Sonar Pinger, a completely self-contained unit that has its own batteries, electric power and control units in water-tight, steel cases designed to resist pressures up to 9 tons per sq in. Accurate to within

3 ft, the instrument already has been used successfully at depths of more than 4 miles. Solar Pinger can be attached quickly and easily at any point on the steel supporting wire between the ship and the equipment at the end of the wire. When lowered into the ocean's depths, it sends two signals back to the ship; one is a direct, upward signal and the other is reflected off the ocean floor. Comparison of the time taken by these two pings to travel to the receiving equipment gives an accurate measurement of the Solar Pinger's distance off the bottom. *Edgerton, Germeshausen & Grier, Inc.*

Circle number (10) on reply card.

Displacement Float Pilot

Applicable for pressures to 4000 psig is a new float operated pilot featuring solid displacement type float completely counterbalanced for normal or interface control. The float, installed in a horizontal or vertical position, drives a non-bleed 30 psig pneumatic relay through a low friction waggle arm. One adjustment is provided for liquid level or interface level and one for proportional band setting. The 400 PF pilot also features direct or indirect action, snap or throttle control. *Kimray, Inc.*

Circle number (11) on reply card.

Pentherm Piping Systems

Penton, trademark of The Hercules Powder Co. for its chlorinated polyether, will be used as a liner, as is saran, for corrosion-resistant pipe, valves, fittings and pumps by The Dow Chemical Co. Dow's trademark for the new products is Pentherm. Inside diameters will be the same as for saran-lined products. Upper temperature limits with Penton are 225 to 250 F. Linings of Penton will be recommended where chemical resistance at higher temperatures is required. *The Dow Chemical Co.*

Circle number (12) on reply card.

For Air Drilling

Self-contained, stationary, air-cooled compressors with capacity and pressure for high-pressure drilling with down-the-hole tools on mobile equipment, as well as production drilling in oil fields, have been introduced. The 3-cylinder 253 "S2" delivers 200 to 275 cfm through a single high compression head from power takeoff or separate engine drive. The 6-cylinder 256 "S2" produces 400 to 600 cfm depending on rpm selected. Air is compressed to 60 psi in the first stage of the com-

Cuneiform Clay Tablet

A matter of interpretation...

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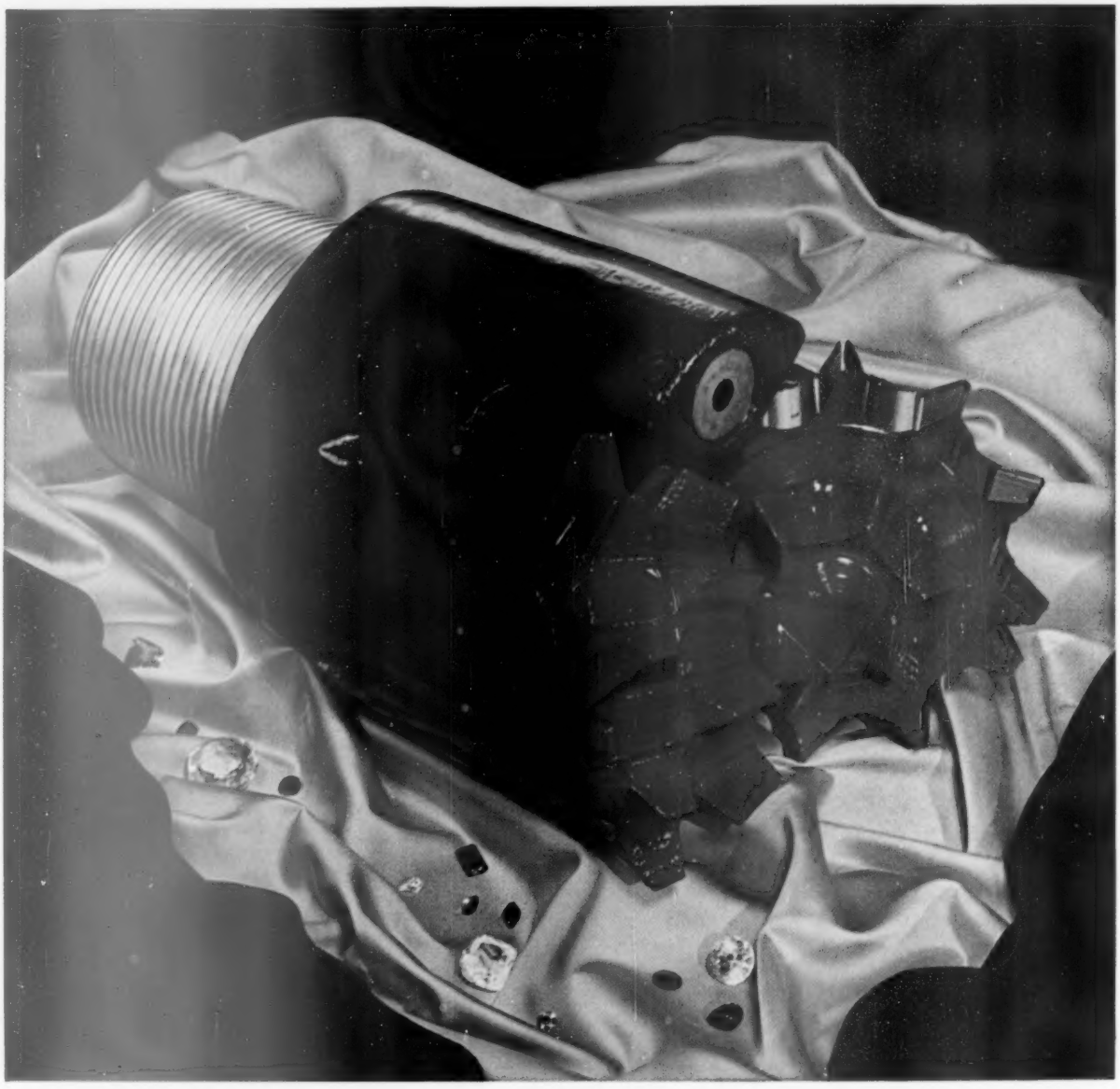
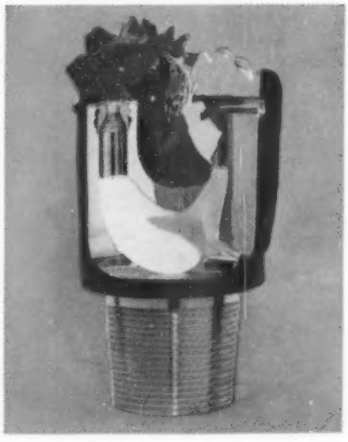
SCHLUMBERGER LEADS IN LOGGING CONSULTATION



A SECURITY FIRST! New Extended Jet 2-Cutter Bit

Nothing drills like the new Security Extended Jet . . . because *there's not another bit like it!* This Security-First in 2-cutter bit design is setting new standards of superior performance. In formations of high drillability where added cleaning of bottom hole is vital, the new 2½" closer-to-bottom jet gives extra penetration speed. Less downtime and more accuracy are assured for straight hole and specialized directional drilling!

Call or write today for complete information and size availabilities on this revolutionary Security FIRST!



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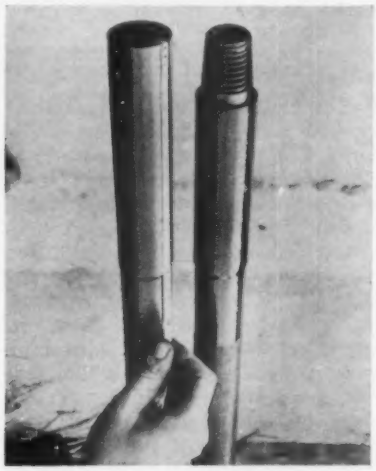
pression cycle and discharged at 250 psi from high pressure cylinders in the second stage. Number of valves in the high pressure head has been reduced and valve assembly altered to resist the higher compression pressures. *Le Roi Div., Westinghouse Air Brake Co.*

Circle number (13) on reply card.

New Tool Joints Designed

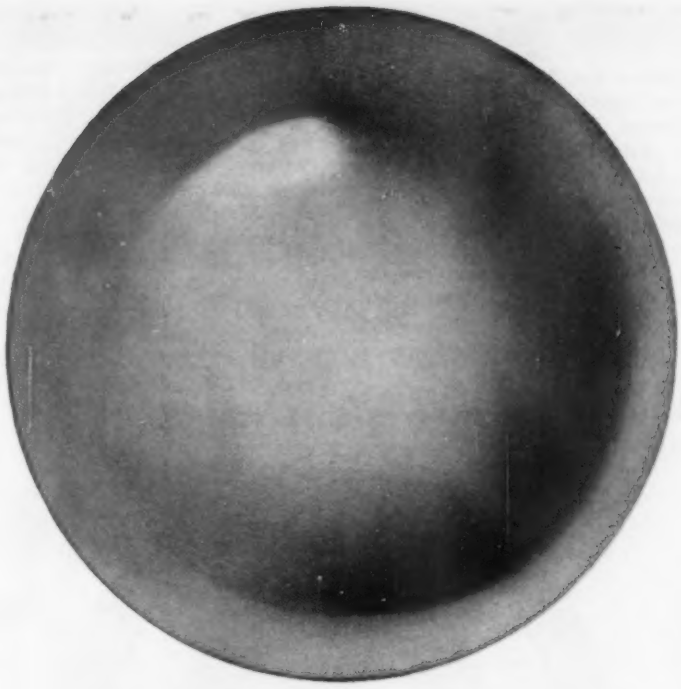


As the result of multiple completions with 2⅞-in. tubing set as permanent casing and deep holes with 4½ and 5-in. smaller lines, two new tool joints have been designed. The 2⅞-in. type PAC answers the request for a joint not larger than 3⅛-in. OD with 1½-in. bore to run on top of drill collars of the same OD to diamond core below the 5-in. liner. The PAC joint uses open hole thread form of 4 threads per in. with 1½-in. taper per ft. It is designed to be installed on 2⅞-in. internal upset drill pipe and can flash to external upset pipe. The 1¼-in. type MT is designed for 1.660-in. OD tubing — normally referred to as 1¼-in. — to drill out cement, packers and do other service work. This is a 6 thread per in. design on 1½-in. taper per ft. Joint is friction welded to tube and can be installed on any plain and (non-upset) tube of any wall thickness. *American Iron & Machine Works Co., Inc.*

Circle number (14) on reply card.

Natural Gas Compressor

A compact, lightweight compressor unit said to be ideal for packaging into economical, portable, skid-mounted units driven by an engine or electric motor is now available. This 3-stage, air-cooled natural gas compressor is designed for use on gas lift rotative systems, as well as for de-watering gas well applica-



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Best in the Oil Patch for Hard Pumping

DuMore is an exceedingly hard alloy composition of chromium, cobalt, and tungsten, a combination of metallurgical properties that is comparable to tungsten carbide—the hardest metal in commercial use today. DuMore Balls and Seats will withstand sand-cutting, ball-pounding, magnetism, high temperature, impact, lodestone, pressure, and the effects of any known corrosive well fluids. Try DuMore the next time you set a pump in a troublesome, hard-to-pump well. You'll be more than satisfied with the service you'll get, and you'll like the way DuMore will reduce those frequent pulling jobs, too.

Harbison-Fischer Mfg. Co., Fort Worth

HF

"BEST PUMPS IN THE OIL PATCH"

tions. The XG-3's short stroke produces low piston speeds. The compressor has feather valve with only one moving part, forced feed lubrication, separator with automatic condensate drain following second-stage intercooler, and oil pressure gage and inter-stage discharge pressure gages conveniently located on fan guard. With capacity up to 145,000 scfd, it is designed for suction pressures of 0-15 psig and discharge pressure from 250 through 600 psig. *Worthington Corp.*
Circle number (15) on reply card.

Friction Welding Introduced

For the first time on the American continents, friction welding has been used to fill an industrial order. The historic welding job involved two new developments — a prototype machine developed by American Machine & Foundry and an American Iron-designed small diameter tool joint which was welded to small diameter tubing to be used for completion and workover. Some 1000 welds were made on the prototype machine in welding male and female tool joints (1.750-in. diam). The machine averaged 20 welds per hr, with runs of 27 per hr occuring frequently. It is reported that improved machines now in design will raise this performance by substantial percentages. The new tool joint, 1¼-in. type MT, allows drillers a new freedom and flexibility in using small size pipe because of its greater strength. *American Iron & Machine Works Co., Inc.*
Circle number (16) on reply card.

Special Valve In New Sizes

The first 8, 10 and 12-in. Teflon-sleeved plug valves are now available. They are gear-operated, have flanged ends and can handle light gases to heavy slurries and corrosives. They feature: specially-tempered Teflon sleeves with sculptured body bore to insure bubble-tight sealing even on temperature fluctuating service; absence of sediment-catching flow pockets; and wiping action of the sleeve on the plug as it rotates to keep it clean and free of adhering solids or liquid films. They are engineered with internal ribbed construction that locks the sleeve in place while permitting sleeve expansion and contraction. *Continental Manufacturing Co.*
Circle number (17) on reply card.

Literature

Used Equipment Bulletin

A new edition of the J&L used equipment bulletin lists used equipment ranging from complete drilling rigs to pumps, rotary tables, pumping units, engines and rubber V-belts. Copies are now available. *Jones & Laughlin Supply Div.*
Circle number (18) on reply card.

Power Digest

Engines spanning the range of 190-2150 bhp are the subject of a 4-page bulletin. Reviewed are 26 models of six basic Superior engines. A brief description and specifications of each engine are supplemented by references to other literature giving more comprehensive coverage of individual models. *White Diesel Engine Div., The White Motor Co.*
Circle number (19) on reply card.

Multiple Completion Handbook

Tubing, casing and valve information and dimensions for use in planning multiple completion programs are compiled in "The Oil and Gas Well Multiple Completion Data

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Now you can reduce costs and simplify valve specifying by using the highly versatile and economical Norriseal Wafer Type Butterfly Valve. Designed for working pressures to 150 psi, the Norriseal Valve features removable and interchangeable rubber and metal seats . . . takes up less line space . . . can be easily and quickly removed for "on-the-spot" maintenance . . . is field repairable. The wide selection of trim available qualifies the Norriseal Valve for use in many oil field and industrial applications.

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Handbook." This general information, unobtainable except from many separate sources elsewhere, reduces the need for lengthy computations in programming multiple completion wells. *W-K-M Div., ACF Industries, Inc.*
Circle number (20) on reply card.

Butterfly Valves

W. C. Norris Division has an 8-page bulletin outlining the company's line of Norriseal wafer type butterfly valves. Included are features, specifications, add items, parts lists, dimensions, and notes on assembly and disassembly of the 150-psi valves. *W. C. Norris Div. Dover Corp.*
Circle number (21) on reply card.

New Tank Gage Described

Dir-O-Gage, a float operated liquid level indicator for installation on bolted or welded tanks up to 24 ft in height, is described in new literature. Attention is called to such features as: easy-to-read dials calibrated in feet, inches and ⅛ inches; Neg'ator motor rewind, no counterweight; and up to eight individually adjustable electric alarm switches in explosion-proof housing. *Instruments, Inc.*
Circle number (22) on reply card.

Books Show Fibercast Uses

Three new pieces of literature describe Fibercast — the centrifugally cast, thermoset epoxy resin, glass fiber reinforced pipe developed to handle special pressure and corrosion problems. The first, in 12 pages, describes applications and physical properties. The second, a 4-pager, outlines details in structural use. The third, in 16 pages, includes tables showing chemical resistance data and specifications for down-hole well tubing. *Fibercast Co., Div. of The Youngstown Sheet and Tube Co.*
Circle number (23) on reply card.

Solder End Gate Valve Data

Bronze, solder-end gate valves added to the OIC line are featured in a new bulletin. These 150-lb WSP — 300-lb WOG, integral seat, solid wedge gate valves are available in sizes ¼ through 2 in., in both rising and non-rising stem design. The bulletin provides complete engineering and dimensional data. *The Ohio Injector Co.*
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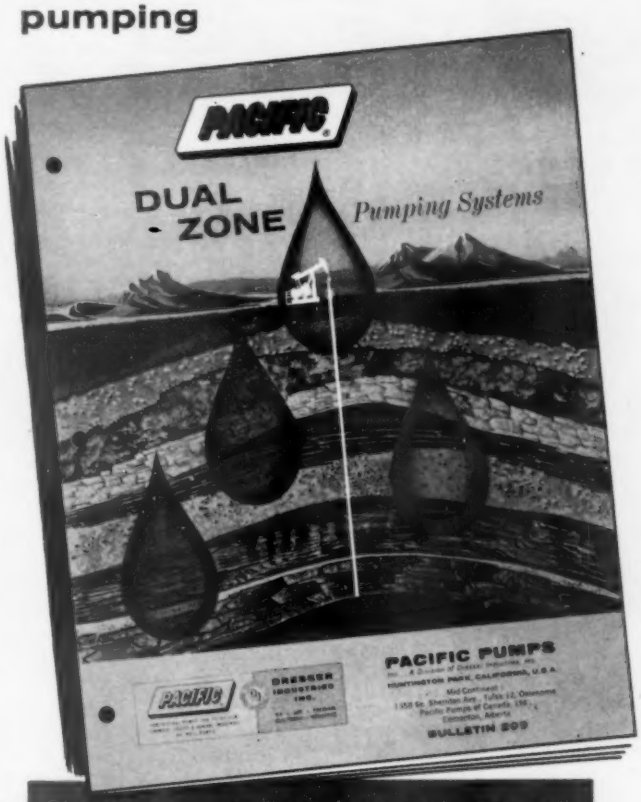
pumping



Write for Bulletin 209

PACIFIC DUAL ZONE pumping systems provide maximum economy in producing dual completed wells where co-mingling of zone fluids is not permitted. Both zones are produced from the same well bore, using a single rod string and pumping unit.

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ALASKA

The August lease sale of six offshore tracts in the Gulf of Alaska, 13,257 acres in all, brought a total of $11,671.55, or an average of $8.35 per acre. Successful bidders were Richfield Oil Corp. and British Petroleum Exploration - Alaska, jointly; Sinclair Oil and Gas Co.; and Socony Mobil Oil Co.

Alaska's next competitive lease sale will be held early in December. Nominations for this sale will be accepted by the Division of Lands. Tracts will be set up and advertised about October 15.

An exploratory well about 17 miles northeast of Homer on the Kenai Peninsula will be drilled by Standard Oil Co. of California, Western Operations, Inc., as operator for itself, and Richfield Oil Corp. The proposed well, Anchor River No. 1, will be some four miles west of Kachemak Bay near the headwaters of the Anchor River and Swift Creek.

ARABIA

Discovery of oil in its twentieth well offshore in Neutral Upper Bahrein by the Arabian Oil Co., a Japanese concern, has been reported by the General Oil Affairs office in Kuwait.

AUSTRALIA

Ohio Oil Co. and Continental Oil Co. have acquired rights to explore more than 8,300,000 acres in Northeast Queensland. Both companies, through wholly owned subsidiaries, obtained an authority to prospect from the Australian government and three Australian companies who had previously held the rights. Ohio and Continental each have a one-half interest in the new area, subject to an overriding royalty retained by the Australian companies. The initial agreement is for four years with the right of renewal for four additional years. Exploratory rights in more than 11,000,000 acres southwest of the new acquisition were previously obtained by the two American companies, jointly with Amerada Petroleum Corp.

BURMA

General Exploration Co. was recently granted oil exploration licenses for some 10,000 square miles in the Irrawaddy Valley by the Burmese government. Union Oil Co. of California may join General in the development of this area in Central Burma. The Irrawaddy Valley, which is said to be geologically similar to the oil producing areas of California, already contains several large oil fields.

CALIFORNIA

Nordon Corp., Ltd., has spudded in the wildcat, McCormick-Abel No. 1-12, to find gas in the Millar area of Solano County. The well is expected to reach a total projected depth of 6300 ft to probe the Upper Cretaceous H and T zones. The lease block is about 560 acres and lies 18 miles southwest of Sacramento. The drill site is located about 2½ miles north of the Maine Prairies field. Millar & York are drilling contractors.

Signal Oil and Gas Co. and Continental Oil Co. have pooled 4000 urban oil leases in the Westwood-Sawtelle area of Los Angeles for wildcat drilling. Signal, operator for itself and Richfield Oil Corp. in West Los Angeles, will operate the exploratory venture for the three companies. The new area of more than 1000 acres is bounded roughly by Santa Monica Blvd. on the north, Kelton Ave. on the east, Exposition Blvd. on the south, and Centinela Ave. on the west. Signal hopes to drill from a site in a secluded M-2 zone west of Sepulveda Blvd. near La Grange Ave. shortly.

Occidental Petroleum Corp. has spudded in its first well on its approximately 6500 acres of leased land on the Kettleman South Dome in the Kettleman Hills area of Kings County about 50 miles north of Bakersfield. The well, named USL No. 27-27, is located 900 ft north and 990 ft south of Section 27, Township 24 south, Range 19 east. It is officially scheduled as a 10,500-ft wildcat.

CANADA

A deep gas discovery in the Green Shale Basin of Central Alberta, about 134 miles northwest of Edmonton, has been completed by Mobil Oil of Canada. The wildcat, Jackfish 10-17, indicated an open flow potential of 6,700,000 cu ft of gas per day from the Devonian-Leduc formation below 11,500 ft. Net pay section is about 27 ft.

Shell Oil of Canada has applied to the federal government for exploratory permits covering 11 million acres of offshore areas off the west coast of Vancouver Island.

HONDURAS

An exploration concession covering 10,195,000 acres has been assigned to the Pure Oil Co. by the government. The concession, located both on land and offshore, covers most of the Mosquitia Basin in the Department of Gracias a Dios in the northeast section of the country. Seismic exploration will begin this month. The land area is sparsely settled. It consists chiefly of grassland, sparse pine forest, and marsh. Pure says that only one well, a dry one, has ever been drilled in Honduras.

IRAN

Iranian Oil Exploration & Producing Co. has abandoned Levan Well No. 1 on Sheykh Shueyb Island, in the Persian Gulf, about midway between Bushire and Bandar Abbas. The well was spudded in April this year. Drilling was discontinued when the well struck a high-pressure salt water show at a depth of 10,466 ft. Although unsuccessful in

proving the existence of oil, the well yielded important geological information.

A new exploratory well, Qeshm No. 4, on Qeshm Island at the entrance to the Persian Gulf, will be started this month.

LIBYA

Concessions covering 6.7 million acres offshore in the Gulf of Sirte, granted to Atlantic Refining Co. in June, 1960, will be explored jointly by Atlantic and Phillips Petroleum Co. The assignment by Atlantic to Phillips of one-half interest in this concession was approved by the Libyan Petroleum Commission. Drilling is expected to begin next year.

LOUISIANA

Union Oil Co. of California has discovered a new deep gas-condensate zone in the Houma field of southern Louisiana. The discovery well, R. R. Barrow, Inc., Unit 3-2, has produced on test at the rate of 6000 Mcf of gas with 100 bbl of 43 deg gravity condensate per day through a ⅛-in. choke with 10,010-psi tubing pressure. The well was perforated from 14,937 to 14,947 with total depth at 14,999 ft in the Bourg sands.

NORWAY

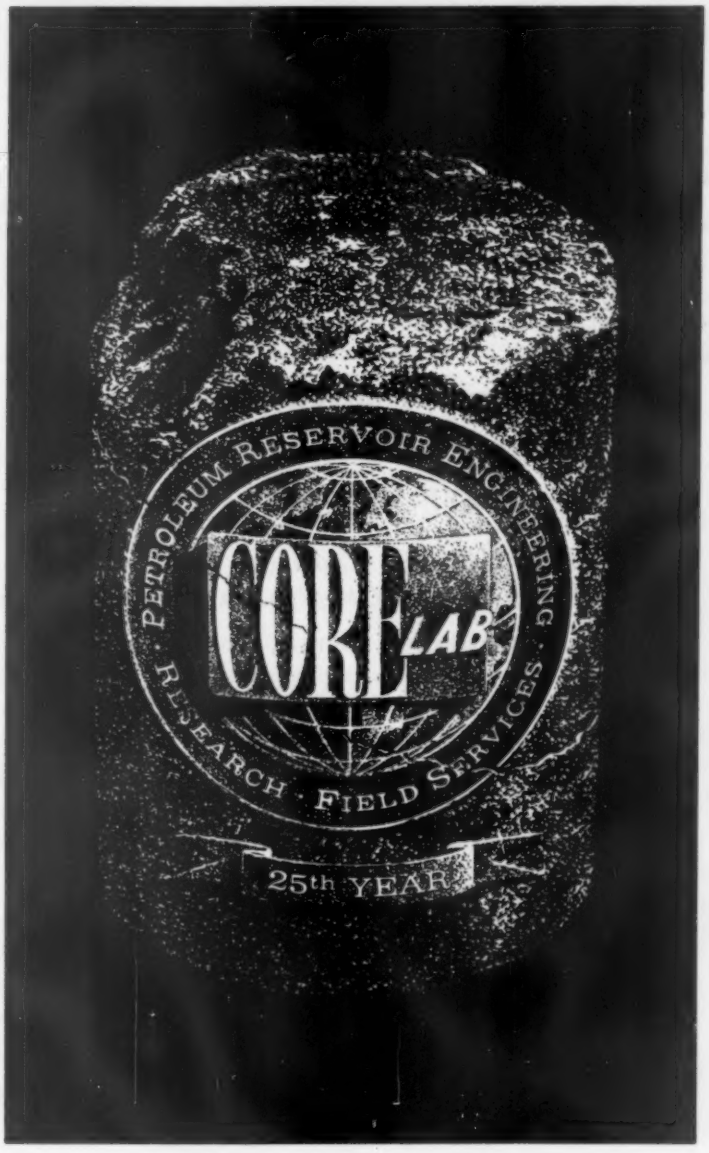
A total of 201 claims covering 500,000 acres on West Spitsberger, Barents Island, and Edge Island have been granted and registered jointly on behalf of California Asiatic Oil Co. and Texaco Overseas Petroleum Co. Geological exploration has already started.

OHIO

Continental Oil Co., Houston, and H. H. & R. Drilling Co., Wichita Falls, plan to drill 25 exploratory wells in Pike and Scioto counties. H. H. & R. will drill the wells on Continental's acreage in these counties. Work will start shortly. Continental has some 750,000 acres under lease in Ohio, southern Michigan, and Kentucky.

OKLAHOMA

Mid-America Minerals, Inc., has tapped initial production flow from the Morrow Zone at No. 1 Bartel, C NW SE 18-2n-23eCM, 1½ miles northwest of the West Elmwood Pool



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in Beaver County. A natural test was made at 7266-76 ft. The well flowed 28 bbl of oil the first hour on a ½-in. choke, 40 bbl of crude on a ½-in. choke in the second hour, and 40 bbl of oil in 45 minutes on a ½-in. choke. The well is shut in.

On a drill-stem test, Ambassador Oil Corp.'s No. 1 Wiens, C SE NW 10-3n-18eCM, Texas County wildcat had good oil recovery in the Upper Morrow Sand zone. The well is 2 miles northwest of the Northeast Hardesty Pool. A one-hour test at 6348-52 ft surfaced gas in 6 minutes at a daily rate of 84,000 cu ft. Recovery consisted of 1115 ft of oil with 175 ft of oil and gas-cut mud.

PERU

Mobil International Oil Co. says that the exploratory natural gas well it is drilling on acreage in eastern Peru shows promising signs. The well, Aguaytia No. 1, is located on 25,000 acres of leases farmed out to Socony Mobil Oil Co.'s foreign operations subsidiary by Peruvian Oils & Minerals, Ltd. which retains a one-third interest in production revenues after Mobil International recovers its development costs. The test well is 40 miles northwest of the Agua Caliente oil field in Peru. A drill-stem test of Aguaytia No. 1 produced a strong gas blow and natural gas liquids. However, there were no indications of what the well would ultimately find.

TEXAS

The Leona area in South Leon County continues to attract wildcatters. W. R. Hughey, Tyler, and W. C. Perryman, Athens, have filed No. 1 Percy Davis as a 7600-ft sub-Clarksville test on a 120-acre lease in the Nathanial Allen survey. Site is 3425 from the southwest and 3725 from the northwest lines of the survey. Location would be about five miles northeast of the Leona sub-Clarksville field.

General Crude Oil Co. 1 Mrs. Elizabeth Morris in the Raywood field of Liberty County has been recompleted as a dual gas distillate well. The Upper Cook Mountain zone of the completion is a new pay for the field. The zone flowed at the daily rate of 8 million cu ft of gas plus 256 bbl of distillate from openings at 10,896-920 ft. The Lower Cook Mountain perforated at 11,-209-50 ft flowed at the daily rate of 5 million cu ft of gas and 40 bbl of distillate.

Blue Danube Oil Co., Fort Worth, has completed a dual discovery from the Pennsylvanian in Southeast Upton County, 1½ miles northeast of Rankin. The firm's No. 1 H. F. Neal, 26-B-HE&WT, rated a daily potential of 637.92 bbl based on a 9-hr flow of 239.25 bbl through a 16/64-in. choke. The oil yield came from perforations at 9336-42 ft, at 9356-64 ft and at 9379-90 ft in the Strawn. Flowing tubing pressure was 1650 psi. The discovery, which is 7 miles northwest of the Block 4 field, is to be dually finished in the Ellenburger from 11,165-268 ft. Latest gage here was 101.75 bbl of oil and 55 bbl of water in 24 hr through ½-in. choke.

WYOMING

A show of oil was found as Pan American Petroleum Corp. continued to explore the Devonian formation of its deep Elk Basin geological wildcat in Park County. The No. 189 Unit, C Lot 5, in 19-58n-99w took a drillstem test of 240 minutes at 5683-741 ft in the Big Horn member of the Devonian and recovered 150 ft of 9-gravity oil and some mud.

COMPANY REDUCES POTENTIAL LOGGING COST FROM QUARTER OF A MILLION TO LESS THAN FIFTY THOUSAND DOLLARS – SAVING 80%!

More than 1200 logs run on workovers and waterflood in old Oklahoma shallow field.

Several years ago the waterflood division of a major company purchased 4200 acres for re-development. Since it was an old field, accurate logs were not available, and an extensive logging program was indicated in completing workovers and the waterflood.

After the pilot flood proved successful, they purchased a Shallow Geo-Logger equipped for Electric, Gamma-Collar, and Caliper logs from Well Reconnaissance.* This equipment was assigned to a member of the production department who ran the logs along with his other duties.

In old wells the Gamma-Collar was used for correlation, for locating bottom of casing, and for determining thickness of the pay zone. The Caliper was used to locate packer seats.

In new wells and converted old wells the Electric and Gamma were used to locate pay zones, and the Caliper was used to calculate cement volume.

After production had started, the Caliper was re-run to check for blockage of the pay zone due to cement, fill-in, or corrosion.

In two and one-half years, more than 1200 logs were recorded. Total cost per log was $25., including equipment and supply costs of $15,000., operator's time and other company expenses.

This application is just one of many in which use of the Geo-Logger has brought about significant savings in operating costs. Ease of operation and a quick equipment payout are major reasons why cost-conscious companies are utilizing Geo-Loggers in their logging programs.

*Well Reconnaissance manufactures Geo-Loggers in depth ranges from 750 to 7500 feet. Any Geo-Logger can be equipped to run, separately or simultaneously, the following logs: Self Potential-Resistivity, Gamma, Casing Collar, Temperature, Caliper, or Tracejector.

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Shale Oil Production Seen Imminent

Commercial production of the trillion-barrel oil potential of shale deposits in Colorado is in sight, according to a report presented to the recent 140th national meeting of the American Chemical Society, Chicago.

A new chemical technique, based on a chemical compound called lithium aluminum hydride, has been devised by chemists to separate kerogen, the oil-forming portion of oil shale, from the mineral portion without materially changing the kerogen. The process was reported by D. L. Lawlor of the U. S. Bureau of Mines, Laramie, Wyoming.

Previous attempts to recover kerogen from oil shale have resulted in unusually high concentrations of mineral impurities, mainly pyrite, in the kerogen. The newly-developed process is successful in reducing the level of this highly-troublesome material from around 5% to 0.02%.

The new technique, used in conjunction with proved methods of removing impurities, produces kerogen containing only about 1% total minerals.

Mr. Lawlor told some 12,000 chemists and chemical engineers attending the meeting that continuing study of the relatively unaltered sample will permit research to find efficient ways of exploiting the huge oil shale deposits.

He explained that kerogen, the organic portion of oil shale, converts to oil at temperatures around 850 to 900 F. His report continued, "Oil shale is one of the greatest untapped natural resources in the United States. The liquid fuel potential of the oil shale deposits located in northwest Colorado in the Green River formation is equivalent to more than one trillion barrels of crude oil.

Forecasters in the petroleum industry might take exception to one report presented to the ACS meeting. A University of Utah professor, George Richard Hill, reported that coal, in place of petroleum, will become increasingly important as a source of hydrocarbon chemicals as a result of recent research progress on coal hydrogenation.

Hill contended that "The high liquid yields made possible by hydrocracking - hydrotreating distillation of high volatile coals plus the marketability of the residual coke make it apparent that there will be a smooth and gradual transition from conventional petroleum refining to coal refining as the economic picture becomes more favorable."

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What's doing in Drilling

Offshore Drilling Takes Giant Step

A huge four-pile drilling platform has gone to work in 180 ft of water at the farthest offshore site in the history of drilling off Louisiana. Operations in Eugene Island Block 269 are 70 miles offshore and conducted by the CATC group (Continental Oil Co., Atlantic Refining Co., Tidewater Oil Co., and Cities Service Production Co.).

The first of five wells to be drilled has been spudded on the platform, which is some 23 miles from nearest production. Initial well will be drilled to 14,000 ft.

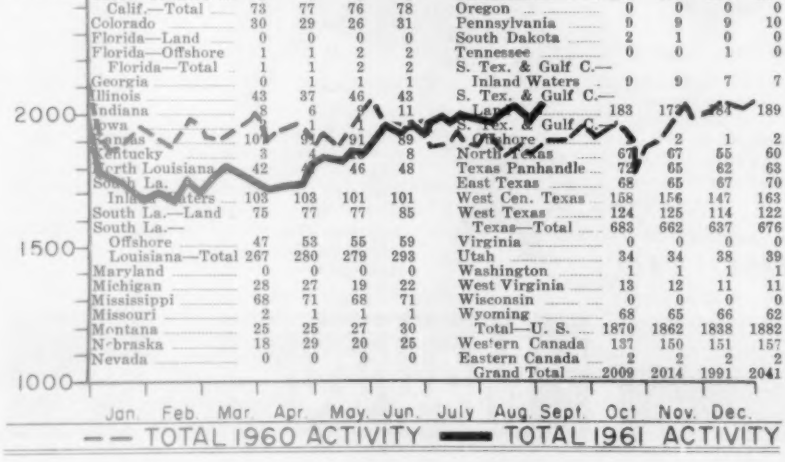
Total height of the structure from the Gulf bottom to the derrick top is 409 ft. The 900-ton unit was constructed by J. Ray McDermott & Co., Inc. The platform has two relatively small decks; a drill deck 54 by 60 ft and a production cellar deck, 30 by 40 ft. The drill deck sits 30 ft above the production deck and serves in place of the conventional derrick substructure.

Wells will be drilled on the larger drill deck which will then be removed, leaving a cluster of five completed wells in an unusually small 4 by 10-ft area. Drill deck will be moved to another location for further offshore drilling.

Rotary Rigs Operating in Oil Fields of United States and Canada

As reported to American Association of Oil Well Drilling Contractors by Hughes Tool Company

	Aug. 14	Aug. 21	Aug. 28	Sept. 4
Alabama	4	6	6	6
Alaska	11	11	11	12
Arkansas	15	13	11	10
Arizona	0	0	0	0
California—Land	71	72	71	73
Calif.—Offshore	2	5	5	5
Calif.—Total	73	77	76	78
Colorado	30	29	26	31
Florida—Land	0	0	0	0
Florida—Offshore	1	1	2	2
Florida—Total	1	1	2	2
Georgia	0	1	1	1
Illinois	43	37	46	43
Indiana	8	6	6	11
Iowa	3	1	1	3
Kansas	101	94	91	89
Kentucky	3	4	7	8
North Louisiana	42	45	46	48
South La. Inland Waters	103	103	101	101
South La.—Land	75	77	77	85
South La.—Offshore	47	53	55	59
Louisiana—Total	267	280	279	293
Maryland	0	0	0	0
Michigan	28	27	19	22
Mississippi	68	71	68	71
Missouri	2	1	1	1
Montana	25	25	27	30
Nebraska	18	29	20	25
Nevada	0	0	0	0
New Mexico	115	127	121	108
New York	1	1	1	1
North Carolina	0	0	0	1
North Dakota	17	16	14	13
Ohio	8	9	7	9
Oklahoma	214	215	223	217
Oregon	0	0	0	0
Pennsylvania	9	9	9	10
South Dakota	2	1	0	0
Tennessee	0	0	1	0
S. Tex. & Gulf C.—Inland Waters	9	9	7	7
S. Tex. & Gulf C.—Land	183	178	181	189
S. Tex. & Gulf C.—Offshore	2	1	2	2
North Texas	67	67	55	60
Texas Panhandle	72	65	62	63
East Texas	68	65	67	70
West Cen. Texas	158	156	147	163
West Texas	124	125	114	122
Texas—Total	683	662	637	676
Virginia	0	0	0	0
Utah	34	34	38	39
Washington	1	1	1	1
West Virginia	13	12	11	11
Wisconsin	0	0	0	0
Wyoming	68	65	66	62
Total—U. S.	1870	1862	1838	1882
Western Canada	137	150	151	157
Eastern Canada	2	2	2	2
Grand Total	2009	2014	1991	2041



Mobil Counts Millions Saved

A hard drive to cut drilling costs saved Mobil Oil Co. and Mobil International several million dollars in 1960 and additional savings are expected in 1961-62. Here are some of the cost-saving steps taken by the companies:

— Combining contract operations with better planning and techniques in the Kathleen Moore area of West Texas resulted in estimated savings of $150,000 - $200,000 per well — 30 to 40% of the total well cost.

— A turnkey contract, slimhole drilling, and better engineering on 10 wells in the Lost Hills area saved Los Angeles Division $1300 per well, or about 50% on the cost of previous wells.

— Omitting waiting-on-cement time from a contract shaved 25 cents per ft from drilling costs.

— Relaxing deviation requirements whittled $4.23 per ft from costs of a Wyoming well.

— Better planning and imaginative use of drilling equipment resulted in a steady improvement in efficiency in the Gulf of Mexico.

— Eliminating surface strings in some Oklahoma wells saves $3000 per well.

— Mobil Oil of Canada saved $4300 per well by going from 5½-in.

to 4½-in. casing, by streamlining the wellhead, and by group contracting on a 20-well program.

— Using drilling vibration absorbers pared expenses of drill pipe and drill collar failure in the Midland Division.

— Using an automatic driller saved the Los Angeles Division 26% in drilling time and 20% in bit costs.

— Selling surplus drilling equipment and reducing warehouse stock added to the cash box in all four Mobile E&P divisions.

—Testing wells with a light workover rig rather than a heavy drilling rig saved about $19,000 per well in Venezuela. Slimhole techniques also saved about $156,000 on 6 wells.

— Improving mud programs and drilling techniques cut wildcatting costs in Libya.

— Using the turbodrill in Germany for directional drilling in soft formations resulted in savings of up to 50% in drilling time.

Air Drilling in Canada

Mobil Oil of Canada's first air-drilling effort has been successfully carried out in a development well in the Carson Creek oil field northwest of Edmonton. A 1855-ft interval was penetrated with air as the drilling fluid instead of conventional mud over a period of 80 hr. Mobil estimates that 180 hr of drilling time would have been required to do the same job with conventional mud.

TV Guides Underwater Drilling

Standard Oil Co. of California, Western Operations, Inc., is using an underwater television camera to guide installation of essential drilling equipment resting on the ocean floor. The TV equipment is carried aboard the charter barge CUSS I, working in 235-ft deep water about 2½ miles offshore on acreage leased from the state.

Moving up and down on guide cables from the open welldeck of the drilling barge, the television camera with its own battery of lights takes the place of a diver in positioning each part of the underwater equipment. Chief advantage of the TV equipment is that it can be used around the clock and is not subject to the bends.

Aluminum Pipe Drills 100,000 Ft

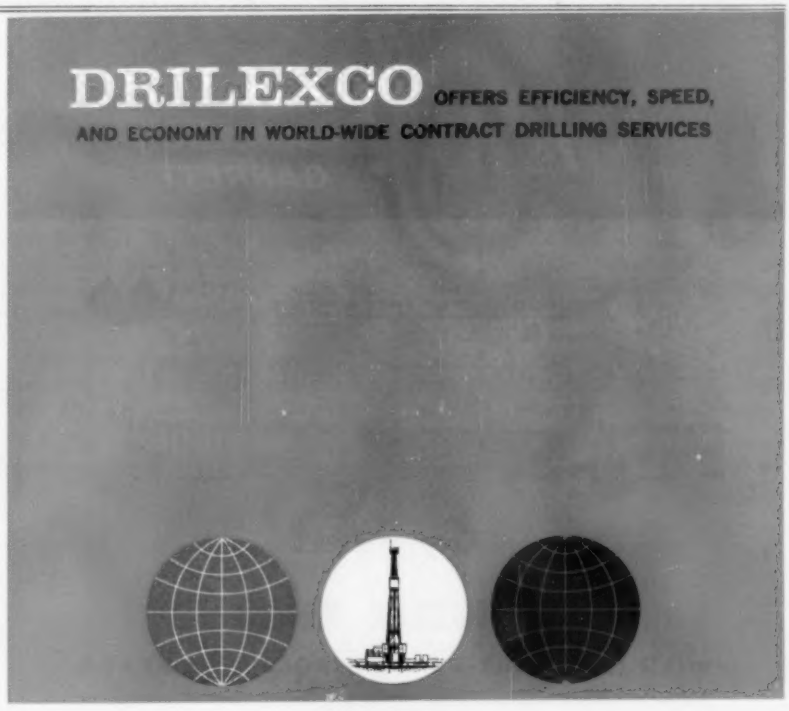
More than 100,000 ft of hole has been drilled by the first string of aluminum drill pipe to undergo extensive field tests. A progress report made by Reynolds Metals Co., manufacturer of the pipe, and Reed Roller Bit Co., manufacturer of the tool joints, showed the pipe's performance during the past year's tests.

Shell Oil Co. has been using the aluminum pipe on a company rig operating in South Texas. Its first test was on a 10,400-ft well in DeWitt County. Shell engineers believe aluminum pipe will replace steel on many of its rigs if the aluminum continues to pass field tests.

The string works on Shell's Rig No. 25, originally designed for drilling depths up to 7500 ft. Light weight of the pipe has permitted drilling holes far deeper than this rated capacity. The hole presently being drilled is to reach a depth of over 11,500 ft.

Driller Sells Production

Pure Oil Co. has contracted for purchase of all capital stock of Davidson Drilling Co., drilling and producing organization, for an undisclosed amount of cash and deferred payments. All drilling equipment and certain other associated service facilities will be conveyed to Davidson Brothers, who plan to engage in



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drilling contract business in West Texas and New Mexico. Davidson will maintain offices at Midland and Fort Worth.

Texas Drillers Pay New Tax

Texas drilling contractors, still not sure how they are affected by the state's new sales tax, are now paying a more positive but unexpected tax: the state highway department is requiring trailers to be licensed before it will issue overweight permits for highway travel.

Previously, permits were granted routinely under a general clause in the vehicle registration statutes which exempted construction machinery. However, the legislature recently amended this clause to apply only to road construction machinery. A delegation of contractors and operators is expected to confer with state officials in efforts to retain the exemption.

Rayna Drilling Expands

Rayna Drilling Co., headquartered at Dallas, has acquired the rotary rigs operated in the Midcontinent area by Tradewinds Drilling Co. (formerly Warren-Bradshaw Drilling Co.) of Tulsa, Oklahoma. Tradewinds will continue to operate 7 rotaries in the Rocky Mountain area.

Ray Bromell, Rayna president, said the company will now operate 10 rotary rigs in Oklahoma and North Texas and has opened offices in the National Bank of Tulsa, headed by T. H. Kerlin, formerly of Tradewinds Drilling and now vice president of Rayna. Paul Lynch is also a vice president at Rayna's Dallas office.

John Schlensker, formerly chief engineer for Great Western Drilling Co., Midland, is now chief engineer for Rayna and will operate out of the Dallas office.

Record Drilling in India

Drillers for Oil India Limited broke the eight-day barrier when they reached the objective at Nahorkatiya Well No. 93 in 7 days and 21 hr. The well was spudded in on July 6 and reached the objective depth of 9229 ft on July 14. The company's previous record was at Nahorkatiya Well No. 73 where the depth of 9404 ft was reached in 8 days and 16 hr.

Oppose Higher Hauling Rates

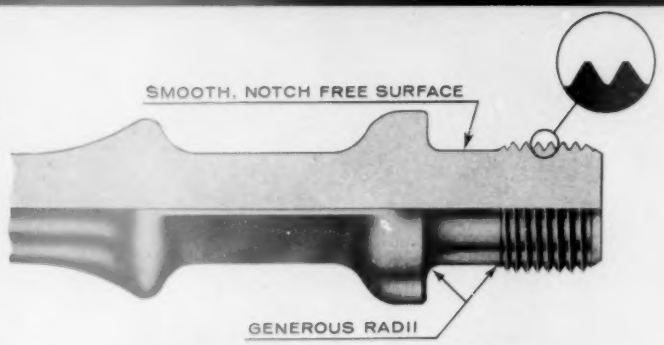
The Shippers Oil Field Traffic Association has joined the AAODC in opposing Application No. 44 filed by the Oil Field Haulers Association with the Texas Railroad Commission. This application seeks so-called "all-inclusive" oil field hauling rates on intrastate shipments within Texas, which would greatly increase the cost of moving rigs.

The Shippers group, meeting in Dallas, also decided to oppose two similar dockets which would boost rig moving costs in the Rocky Mountain area. The two identical dockets, filed by Midwest Motor Carriers Bureau and the Oil Field Haulers Association, seek an additional 10 cents per 100 lb on interstate oil field machinery moves with the Rocky Mountain states.

New Drilling Firm

The Glasscock-Chapman Drilling Co., Inc., has been formed with Roger C. Chapman as president. He was district landman for Midwest Oil Corp., Lafayette District, for the previous five years. The new company will have offices in Building 28 at the Oil Center in Lafayette, Louisiana. C. W. Glasscock, Jr., vice president of the organization, will have offices at 1202 Petroleum Tower, Shreveport.

NEW! AT AXELSON-GARRETT



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Running Tour

In Phillips Petroleum Co.'s production department, S. I. Betzer has been named superintendent of the Panhandle district, Borger, Tex., and R. W. O'Neill district superintendent of the North Burbank unit, Shidler, Okla. District foreman of the North Burbank unit will be J. L. Bowden, formerly development foreman for the Guymon, Okla., district.

Husky Oil Co.'s land and exploration offices in the U.S. have been consolidated at Denver, Colo. Moving to the new office from Midland, Tex., are Norris N. Requist, chief geologist, and W. C. Kimball, land department manager. A.V.R. Coe, Rocky Mountains district geologist, and O. E. Marty, draftsman, will move to Denver from Cody, Wyo. The firm will maintain its production office and district land office in Cody and production office and geologist in Midland.

Floyd E. Suder, Jr., has joined Forest Oil Corp. as a reservoir engineer, a position he formerly held with Ada Oil Co.

John I. Fisher fills the new position of division production manager in Kerr-McGee Oil Industries' Gulf Coast production division office. G. Emery Guidry continues as division superintendent.

New officers of the Society of Exploration Geophysicists are: president, Dr. Lawrence Y. Faust, geophysical supervisor for Amerada Petroleum Corp.; first vice president, Dr. Milton B. Dobrin, chief geophysicist for United Geophysical Corp.; vice president, Stanley H. Ward, consulting geophysicist and associate professor of mineral exploration, University of California; secretary-treasurer, R. Maxey Pinson, Midland, Tex., division geophysicist, Union Oil Co. of California; and editor, R. B. Rice, supervisor of the physics department, Ohio Oil Co. New officers will assume office at the society's 31st annual international meeting, Nov. 5-9, Denver, Colo.

B. P. Eastin is now vice president, production, Shell Oil Co. J. D. Goodrich succeeds Eastin as direc-

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EXPLOSION!
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tor of production research, Shell Development Co.'s E and P research division. P. A. Dennie succeeds Goodrich as production manager in the Denver, Colo., area. Durland E. Clark succeeds Dennie as assistant to the vice president, Pacific Coast exploration and production area.

Robert M. Taubman and Associates is a new exploration and production organization in Midland, Tex. Robert M. Taubman has been a vice president of Buffalo Petroleum Corp. and manager of its West Texas-New Mexico Div., which recently closed its Midland office. In addition to Taubman, the staff consists of three former Buffalo supervisors in Midland: Neal Taylor, engineer; Curtis Espy who will be in charge of exploration; and Joann Putman, executive secretary and office manager. Taubman and his staff will continue to supervise operation of Buffalo's properties in West Texas and Southeast New Mexico.

Russ Lindvell has transferred from Sterling, Colo., to become new production foreman for British-American Oil Producing Co. in Midland, Tex.

D. M. (Bud) McDonald is new division manager of Clark Oil & Refining Corp.'s Canadian exploration and production operations. He formerly was division landman for Honolulu Oil Corp.'s Canadian operations.

Continental Oil Co. has consolidated its Salt Lake City, Utah, and Denver, Colo., exploration divisions into one division headquartered in Denver.

Several engineers have announced their availability as petroleum consultants:

Max E. Curry, formerly division reservoir engineer for Buffalo Petroleum Corp., Midland, Tex., is now operating as a petroleum engineering consultant from offices in his Midland residence.

W. S. Crake is retiring from Shell Development Co. after 34½ years' Shell service and will offer consulting service on drilling problems, particularly in the area of air and gas drilling. He will headquarter in Houston, Tex.

R. M. Dost, Mt. Vernon, Ill., will specialize in waterflood evaluation, design and operation, unitization representation and well completion. He resigned his position as division production manager for Kingwood Oil Co. to become a consultant.

Ralph H. Viney has resigned as vice president and petroleum engineer of the First National Bank of Ft. Worth, Tex., to establish consultant offices in Ft. Worth.

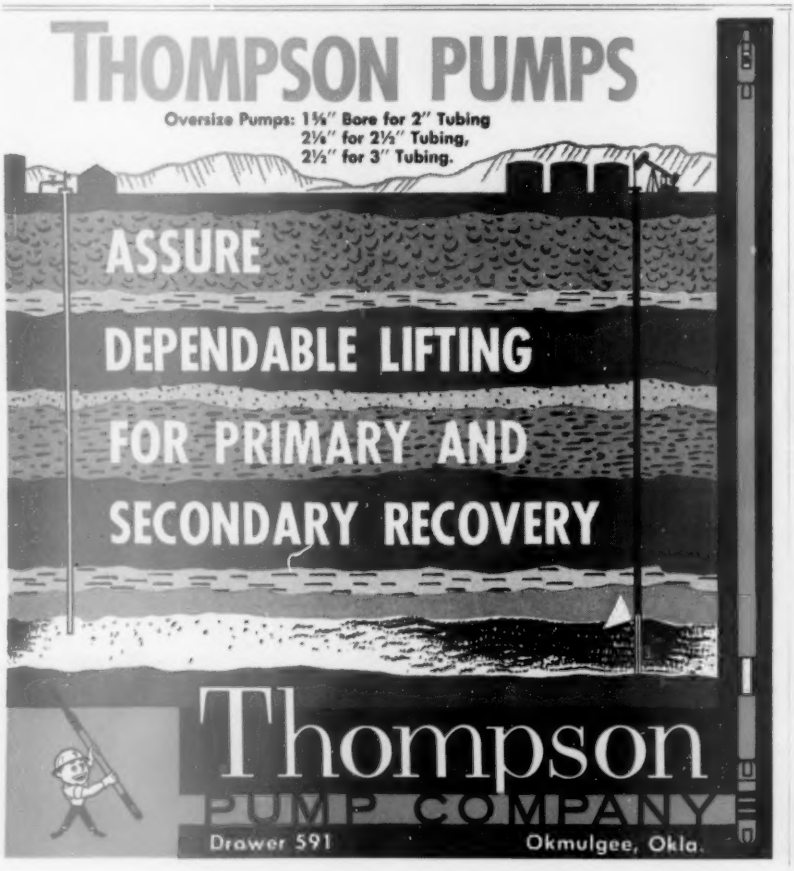
Walter Leabo, manager of International Drilling Co.'s Gach Saran division, near Abadan, Iran, died of a heart attack July 5. He had been associated with IDC in Kuwait, Libya and Iran since 1957. Prior to joining IDC, he was associated with Texaco Inc., Circle Drilling and Southern Six Drilling Co., Inc.

New vice presidents of Oil Recovery Corp. are: Lee Bentley, contractual relations; J. J. Christensen, production and engineering; and Frederick E. Merliss, research and development.

Group chairmen and co-chairmen for the 15th annual Midwestern Exploration Meeting, to be sponsored by the midwestern sections of the Society of Exploration Geophysicists and the Ft. Worth Geological Society next March 15-16 in Ft. Worth, Tex., have been announced. In addition to general chairman Paul H. Ledyard, they are: William L. Gupton, general co-chairman; Walter D. Baird and Castle J. Harvey, program chairman and co-chairman, respectively; Floyd Acklin, Jr., arrangements co-chairman; Howard Itten, finance chairman; and T. F. Newman, finance co-chairman.

Texaco Inc. has changed its geological organization at Houston and Midland, Tex., and New Orleans, La. L. A. Kuebler is new assistant division geologist, Midland. R. B. Franklin succeeds him as geologist in the general manager's office, Houston, and D. F. Beaumont has been advanced to assistant division geologist, New Orleans, replacing Franklin.

Elected a director and executive vice president of Canadian Homestead Oils, Ltd., is Bruce W. Watson, formerly a vice president. He also is vice president and a direc-



tor of Ranchmen's Oils (1957), Ltd., and Palliser Petroleums, Ltd., and manager of Castle Oil & Gas, Ltd.

Tidewater Oil Co.'s southern division has transferred its South Texas district production office from Houston to Corpus Christi, Tex., to complete the headquartering of both production and exploration activities for the district in the same location. L. D. Lott is district production manager, and S. H. LaCroix is his assistant.

Dr. M. King Hubbert has been appointed visiting professor of geology and geophysics of Stanford University for the 1961-62 and 1962-63 winter quarters and will teach a course on "Physics of Underground Fluids." While at Stanford, he will retain his affiliation with Shell Development Co. as consultant in general geology.

G. E. Burpee, assistant to the Houston area vice president, Shell Oil Co., has retired after more than 29 years with the company.

Murphy Corp. has named Earl B. Austin, Jr., manager of its Denver division, production and exploration. The firm also has appointed George C. Howard staff geophysicist.

Helmerich & Payne, Inc., has promoted W. A. Black to general production superintendent.

An oil and gas property management company, Parva Petroleum Co., has been formed by Lee J. Thronson, formerly vice president in charge of operations for Oil and Gas Property Management, Inc., and Nafco Oil and Gas, Inc. The new firm will headquarter in Corpus Christi, Tex.

Richard A. Morse will be the 1962 president of the Society of Petroleum Engineers of AIME, taking office in February 1962. Morse is associate director of research on oil and gas production and transportation for Gulf Research & Development Co., Pittsburgh, Pa. He will replace 1961 President Earl M. Kipp. New members of the SPE Board of Directors are: E. S. Morris, Herman A. Engel, Jr., John M. C. Gaffron, Ivan Tucker, William R. Waag, and Jimmie D. Harrington.

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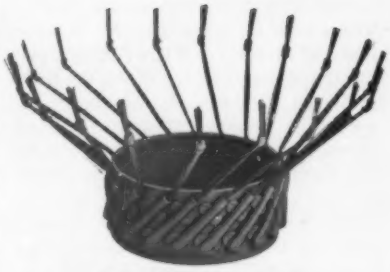

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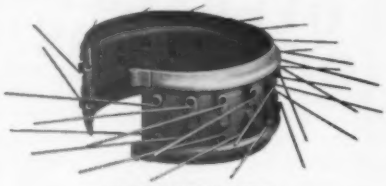

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Mobil Oil's Midland, Tex., exploration and production division announces reassignment of F. F. Turner from the drilling department, Hobbs, N. M., producing district, to utilityman, Wichita Falls, Tex., producing district, and J. D. Stephens, production engineer, from Mobil Oil of Canada to the Midland producing district, Midland division.

William A. Fuller, owner and operator of extensive oil and ranch interests in Texas, Louisiana and the Rocky Mountain area, has been elected a director of Ft. Worth National Bank. The bank also has appointed as assistant vice president Peter A. MacQueen, a petroleum engineer who joined the bank's oil loan division in 1960.

Recent managerial appointments to the New York producing staff of Texaco Inc.: Charles W. Saville, general manager of the foreign producing department (Western Hemisphere); Edwin L. Gorham Jr., assistant general manager (operations) of the department; Robert H. Martin, chairman of the executive producing committee, succeeding Saville, and Robert N. Harding, assistant to the senior vice president.

Charles E. Hannon has opened an office as a consulting petroleum engineer at Midland, Tex. He formerly was a petroleum engineer in Texas Pacific Coal & Oil's Odessa, Tex., office.

Bert P. Eastin, Houston, director of production research and exploration for Shell Development Co., has been advanced to production vice president for Shell Oil Co. with New York headquarters. He succeeds J. E. Clark, recently made executive vice president in charge of exploration and production.

J. D. Goodrich, formerly production manager of the Denver exploration and production area, will assume Eastin's Shell Development position, while P. A. Dennie, formerly assistant to the vice president of the Pacific Coast area, will succeed Goodrich.

Hal B. Fullerton, Jr., is new vice president of Arrow Drilling Co., Tulsa, Okla. He formerly was vice president of Santa Fe Drilling Co. and general manager of its operations in the eastern hemisphere.

D. W. Gresser, San Gabriel, Calif., has been named area geologist in Shell Oil's Pacific Coast area.

Avery Island production district office of Humble Oil & Refining Co. has been transferred to Lafayette from New Iberia, La. The new Lafayette district headed by J. P. Nolley, district superintendent, will also be responsible for administration of the company's gas plant at Opelousas and will be one of the four districts making up the company's New Orleans area. E. G. Copley, superintendent, will remain in direct charge of the gas plant's operations.

Kenneth D. McPeters, formerly associated with John M. Kelly who is now assistant secretary of the Department of Interior, has opened a petroleum consulting office in Hobbs, N. M.

Promoted to senior vice president and treasurer of Ambassador Oil Corp. is W. V. Coffey, who has been a vice president and treasurer since the firm's formation in 1956. Formerly, he was general manager for Star Oil Co.

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THE GLOBALOY MILL SHOE

An Indispensable Accessory to the GLOBE JUNK BASKET

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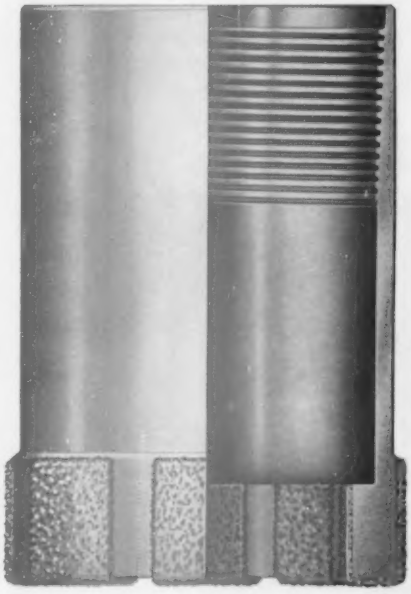
For Fast, Safe, Economical Milling of All Types of Junk During Fishing Operations



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THE GLOBALOY MILL SHOE represents a metallurgical milestone in safe, fast, economical, rough abrasive milling operations. An exclusive product of Globe Oil Tools Company, GLOBALOY consists of sintered tungsten carbide particles which are applied to Mill Shoes by a special binding process which suspends the carbide particles in a strong mold. An infinite number of sintered cutting particles support all sides of the GLOBALOY MILL SHOE to provide continuous self-sharpening no matter how difficult the milling job. When one cutting edge dulls, another takes over until the entire matrix is exhausted. GLOBALOY MILL SHOES cut faster, require fewer round trips and provide greater economy and safety. A complete range of sizes.

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Suppliers' Parade

Kenneth D. Fisher has been elected president of Cherokee Laboratories, Inc. He will continue to headquarter at Longview, Tex., where he has been vice president of sales. Robert Denny continues as vice president and treasurer of Cherokee and its three new subsidiaries: Cherco Equipment, Inc.; Garzo, Inc.; and Polymeros, Inc.

G. W. "Bill" Davidson, a 26-year veteran with the W. C. Norris Div. of Dover Corp., has been appointed the firm's executive vice president. Vice president in charge of sales for the past eight years, he will continue to direct activities of the company's sales, marketing and research groups.

Sam Martinez has resigned as technical editor for Dowell Div. of The Dow Chemical Co. to become assistant professor in the University of Tulsa's department of information services.

Noah E. Hull, assistant to the vice president, manufacturing, Hughes Tool Co., has retired after 15 years with Hughes and 35 years in the ranks of professional engineer.

With four out of every five booths already contracted for, the October 19-22 Louisiana Gulf Coast Oil Exposition is expected to repeat the last show's sellout of space. Information on remaining interior and exterior exhibit spaces may be obtained from LAGCOE executive secretary, Miss Rose Martin, Box 1392, Oil Center Station, Lafayette, La.

Magcobar Div. of Dresser (Germany) GmbH has been established by Magnet Cove Barium Corp., one of the Dresser Industries, to market Magcobar drilling mud products in West Germany. Johannes Hubert Kuckertz has been appointed manager, with headquarters at Drakenburg 293/Kreis.

Montello, Inc., has consolidated all processing, warehousing, shipping and traffic departments into one central industrial area. The firm's new plant is located in Sand Springs, Okla.

Reed Roller Bit Co. has purchased Diamond Metal Co., manufacturer of tungsten carbide surfacing materials and castings and "tungsten heavy metal" used as a shield against radiation. J. R. Henderson, president of Diamond Metal, remains in the top managerial post at Diamond, which will now operate as a division of Reed. Plant and headquarters will remain at 9430 Telephone Rd., Houston, Tex.

National Tube Div., United States Steel Corp., has discontinued the 4% discount being allowed distributors on shipments into their warehouse stocks because it has not been effective in encouraging increased warehousing of oil country goods by its distributors. The regular 6% distributor discount continues unchanged on all oil country goods. Prices for oil country drill pipe remain unchanged, and the 4% warehousing discount on shipments to distributors' stocks continues applicable to this product.

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PC91

PERFORMANCE DATA

TYPE	FT. DRILLED	HOURS RUN	FT./HR.
MAKE A, ROCK BIT	3	2	1.5
MAKE B, ROCK BIT	11	5	2.2
HYCALOG, DIAMOND PC 91	1440	240	6.0

AT 12,000'-13,000' DEPTHS in South Louisiana where this run was made, the saving in trip time alone amounted to thousands of dollars. And the diamond bit cost no more than the dozens of conventional bits which would have been required to do the same job.

No isolated case, this is one of a long list of records. So why not let a Hycalog diamond bit set a profit-making record for you.

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Appointments and Promotions

Continental-Emsco Co.—Max Marstrand, purchasing agent in the Dallas general offices; and W. E. Lasseter, succeeding Marstrand as Oklahoma-Kansas division merchandise manager.

Grove Valve and Regulator Co.—Kenneth S. Adamson, application engineer specializing in regulators, formerly manager of sales/engineering for Pre-Flite division of Avco Corp. and sales engineer for electro-dynamic division of General Dynamics.

Magnet Cove Barium Corp.—Robert W. Ruhe, Jr., chief service engineer, formerly staff service engineer.

W. C. Norris Div., Dover Corp.—Harry R. Ramsey, tri-state sales division, Mt. Pleasant, Mich., to service accounts in Michigan, Ohio and Ontario, Canada, formerly division manager for Turret Supply Co., Ltd.

Oil Well Supply Div., United States Steel Corp.—Lawrence D. Kinnan, district manager, Houston, Tex.; James W. Coburn, district manager, Oklahoma City, Okla.; Grant A. Jackson, Mid-Continent area manager, tubular sales; Roy A. Johnston, Jr., field representative, El Dorado, Ark.; C. H. Stewart, manager of the Garland, Tex., works; and J. F. Brown, manager of production at Garland.

Schlumberger Well Surveying Corp.—J. A. Burke, sales engineer, Permian Basin division; K. S. Howell, sales engineer, Texas Gulf Coast division; C. E. Tedrow, senior sales engineer, Wichita, Kan.; B. M. Ray, location manager at Pampa, Tex.; H. J. Nickle, location manager, Wichita district office; W. C. Graves, sales engineer, Natchez, Miss.; and L. D. Thomas, senior sales engineer, Oklahoma City.

Security Engineering Div., Dresser Industries, Inc.—Claude R. Whelchel, special sales representative, Gulf Coast division.

Worthington Corp.—William A. Meiter, to the newly-created post of vice president, Washington services; and Hunt Davis, director, fluid machinery engineering, Harrison division.

DELIVERY: Often a challenge!

Delivering this 165 foot, 135 ton fractionating tower on schedule often had its moments.

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Our diversification applies to delivery also. Besides our experience with railroads, being on the hub of the Delaware River makes us a natural for shipment by water.

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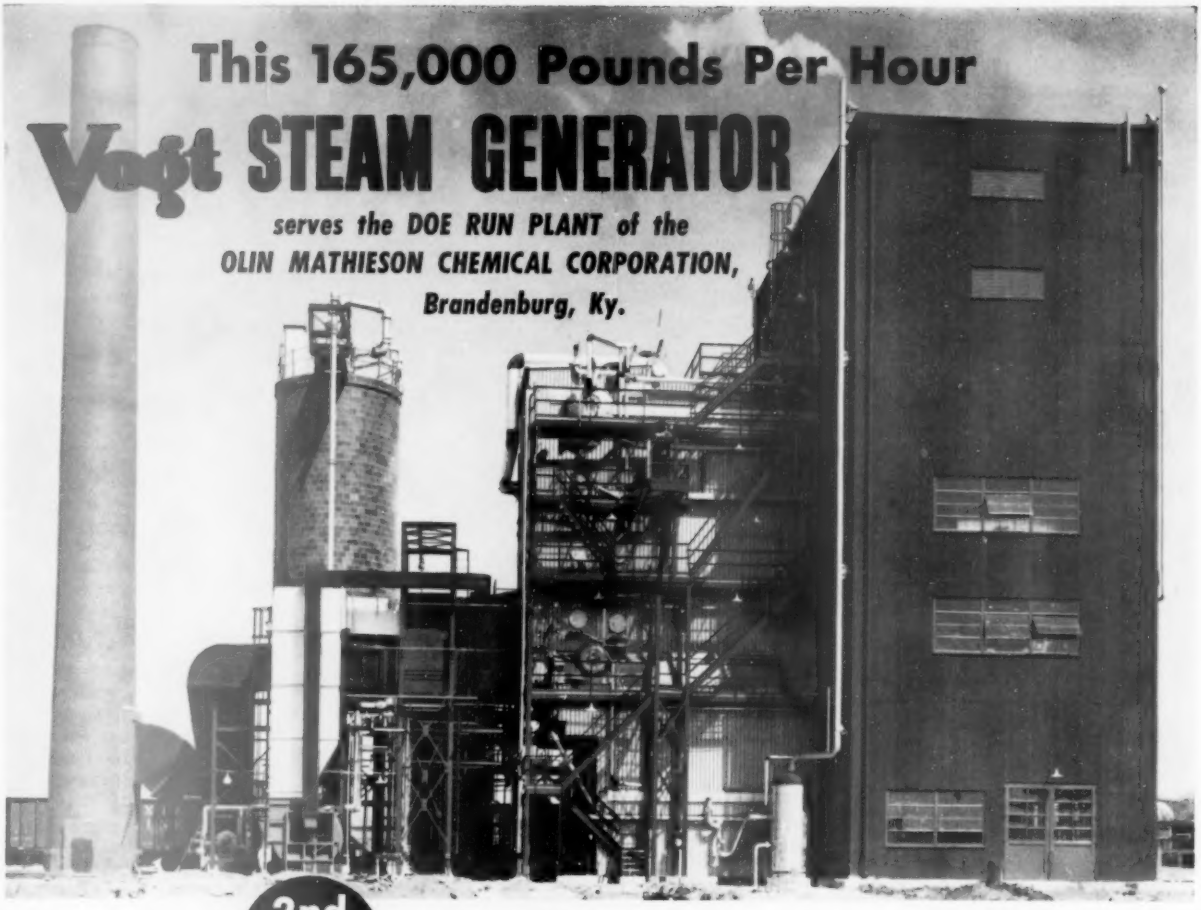
serves the DOE RUN PLANT of the OLIN MATHIESON CHEMICAL CORPORATION, Brandenburg, Ky.



Installed out-in-the-open, the unit generates 165,000 pounds of steam per hour at an operating pressure of 650 psig and 750°F. total temperature when firing pulverized coal or gas in a tangent tube, fully water cooled, pressure tight, steel encased setting.

Outdoor installations, with firing equipment housed, have been promoted by Vogt for many years. They help reduce building and operating costs in leading chemical plants and refineries across the nation.

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Construction Briefs

A 100,000-bpd refinery on Mississippi's Gulf Coast and two more big petro/naphthalene plants highlight HPI construction news this month.

Merging Standard Oil Co. of Kentucky and Standard Oil Co. of California propose to build a $125,000,000 refinery near Pascagoula. Mississippians were to vote Oct. 3 in a state-wide referendum on constitutional amendments to permit 10-year tax exemptions and allow the companies to acquire 533 acres of county-owned land.

Texaco Inc. will erect a multimillion dollar naphthalene plant to produce 100,000,000 lb of the petrochemical annually at its Port Arthur, Tex., refinery. Plant will go onstream by 1963.

Cities Service has announced plans for a 50,000,000-lb-per-year naphthalene plant to be completed in mid-1962 at the East Chicago, Ind., refinery.

Other key contracts awarded to:

Foster Wheeler Corp.'s French subsidiary, for design and supervision of construction and startup of a multi-million dollar expansion project at the Kruisschans refinery, Antwerp, Belgium, of Societe Industrielle Belge des Petroles.

Canadian Bechtel Ltd., Toronto, for building distillation facilities to raise capacity of Imperial Oil's Sarnia, Ontario, refinery by 16,000 bpd from current capacity of 94,000 bpd. Total cost is estimated at $3,000,000.

Blaw-Knox Co., Pittsburgh, for design and construction of Cary Chemicals' new 100,000,000-lb-per-year polyvinyl chloride plant near Burlington, N. J., at cost of $4,000,000.

Fluor Corp., for construction of a helium extraction plant at Bushton, Kans., for Helex Co., subsidiary of Northern Natural Gas Co., Omaha, Neb. Plant will be capable of producing raw helium at rate of 700 MMcf a year for sale to U.S. government.

Badger NV, for design-engineering-construction of phthalic anhydride plant at Hoek van Holland for NV Chemische Industrie Synries, 50% owned by Allied Chemical Co.

Bechtel Corp., San Francisco, for multi-million dollar modernization program at Gulf Oil's Cincinnati refinery. Included is installation of an atmospheric and vacuum crude distillation unit, a Gulfiner and a CO boiler, plus complete renovation of several existing facilities. Capacity will be upped from 28,000 to 32,000 bpd.

Fish International Corp., Houston, for construction of a $7,500,000 petrochemical plant at Rio Tercero, Argentina, for Hooker Chemical Co., New York, and Atanor (Compania Nacional para la Industria Quimca, SA), Buenos Aires.

Stone & Webster, for design of ethylene and butyraldehyde facilities at a $20,000,000 industrial complex for production of butanol and octanol by synthesis from naphtha at Yokkaichi, near Nagoya, Japan. Plants will be operated by Daikyowa Petrochemical Co., formed by Daikyo Oil Co. and Kyowa Fermentation Industry Co.

O. L. Olsen Co., Houston, for expansion of facilities at Tenneco Oil Co.'s Leabo natural gas processing plant in Matagorda County, Texas, to increase capacity to 90 MMcf a day, almost twice the previous capacity.

Southwestern Engineering Co., for construction of a $500,000 gasoline recovery plant at Carpenteria, Calif., to serve offshore oil producing properties jointly owned by Standard Oil Co. of California, Western Operations, Inc., and Humble Oil & Refining Co. It will replace three rented units now in service and will boost handling capacity to 20 MMcf of natural gas daily.

Foster Wheeler Corp., for Texaco's new 28,000-bpd delayed coking unit at the Lockport, Ill., refinery.

Fluor Corp., for two hydrogen treating units with combined capacity of 25,000 bpd at Shell Oil's Anacortes, Wash., refinery.

Other new plants announced:

Cities Service Helex $20,000,000 helium extraction plant near Ulysses, Kans., to process 505 MMcf of natural gas per day and deliver 2 MMcf of helium per day.

Hawkeye Chemical Co.'s $10,000,000 nitrogen products plant at Clinton, Iowa. Capacity will be about 300 tons daily, with ammonia, nitric acid, nitrate solution, ammonium nitrate, urea and nitrogen solutions the principal products. Hawkeye is jointly owned by Skelly Oil Co. and Swift & Co.

Pennsalt Chemicals' $2,000,000 expansion that will nearly double capacity of its alkyl amines unit at Wyandotte, Mich. Expanded unit will be the world's largest for making ethylamines, isopropylamines and butylamines.

Mobay Chemical Co.'s multi-purpose facilities for manufacture of a broad range of organic isocyanates, adjacent to its toluene diisocyanate plant at New Martinsville, W. Va.

Esso Standard Eastern's 100,000-ton-per-year plant at Trombay, India, to produce ethylene, propylene, benzene and other petrochemicals for naphtha feedstock. A new 50%-owned Indian company will operate the plant. Authorized capital will be $10,500,000.

Dekachimie's $6,000,000 isocyanates plant near Lille, France, jointly owned by Du Pont and Etablissements Kuhlmann, Paris.

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UPGRADE PRODUCT QUALITY

IMPROVE OPERATING EFFICIENCY

REDUCE MAINTENANCE COSTS

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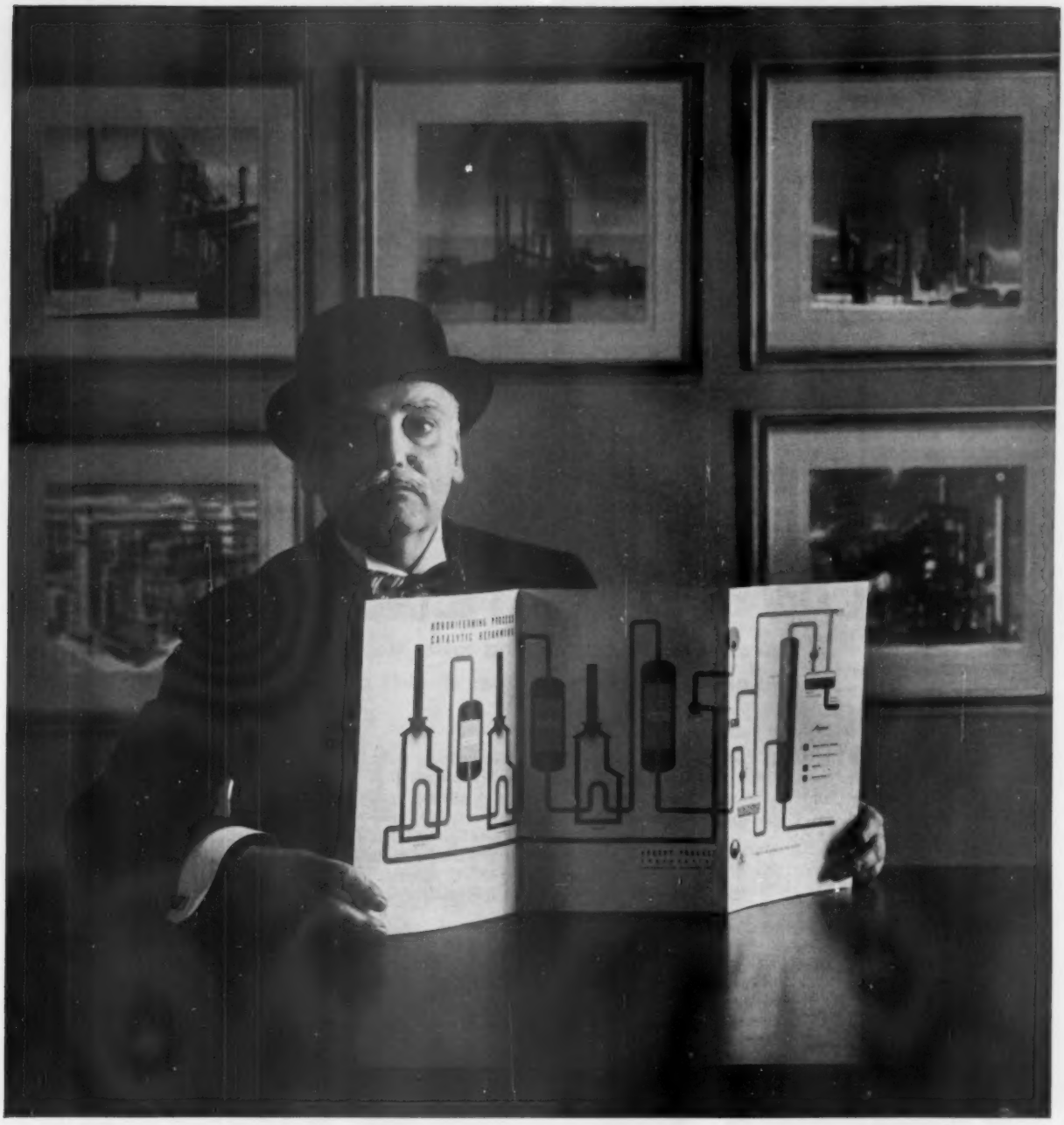

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HELPFUL WATER CONDITIONING DATA FROM BETZ

HOW TO EXTEND COOLING

The deterioration of cooling tower wood by chemical, biological and physical factors shortens the life of cooling towers.

OVER THE PAST DECADE considerable attention has been focused on the problem of cooling tower wood deterioration—and for good reasons. Complete collapse of some cooling towers has occurred. In other cases, fan supports have deteriorated, and the fans have fallen through the tower. Accidents have occurred due to collapse of ladders, decking and other parts of the tower. Wood deterioration has shortened the life of cooling towers from the anticipated 20-25 years to 10 years or less in many cases. Repairs and replacement costs have been excessive, and cooling tower operation has been inefficient. During the past decade, many organizations have been engaged in a study of the problem to determine the causes and possible cures. Since water is an intimate part of the problem, Betz Laboratories is actively engaged in the study of wood deterioration.

Cooling Tower Wood Composition

Redwood is the most commonly used material for cooling tower construction. It has been in use for this purpose almost since the advent of cooling towers themselves. Originally, this material was selected because of high strength to weight ratio, ready availability, ease of fabrication, cost and natural resistance to decay. Other species are used for this purpose, particularly Douglas Fir and less frequently cypress and pine.

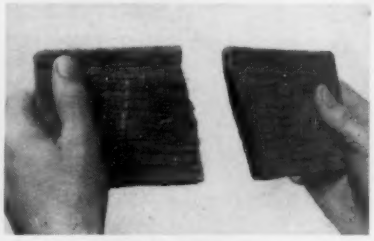
Wood is composed of three main components; cellulose, lignin and natural extractives. The cellulose exists as long fibers almost identical to cotton fibers, and gives wood its strength. The lignin acts as the cementing agent for the cellulose. The extractives contain most of the natural compounds which contribute to the resistance to decay. In general, the more highly colored woods are the more durable. A typical analysis of redwood, based on the dry weight, will show approximately 50% cellulose and hemi-cellulose, 30% lignin and 20% extractives. The extractives present in redwood make this material one of the most resistant to decay. Unfortunately, the extractives present in all woods are largely water soluble, and will be leached from the wood by the circulating water. The strength of the lumber does not appear to be affected by leaching. However, the wood does become more susceptible to decay.

Types of Wood Deterioration

Cooling tower wood is subject to three main types of deterioration; chemical, biological, and physical. It is rare where one of these types of deterioration is present without the other. In most cases these different types of deterioration occur simultaneously. When deterioration occurs it is difficult to determine which type of attack is predominately responsible. However, it is evident that physical and chemical deterioration will render the wood more susceptible to biological attack.

Chemical Attack

Chemical deterioration of cooling tower wood commonly is manifested in the form of delignification. Since the lignin component of the wood is affected and removed by this type attack, the resultant residue is rich in cellulose. The chemicals most commonly responsible are oxidizing agents such as chlorine, and alkaline materials such as sodium bicarbonate and sodium carbonate. *The attack is particularly severe when the combination of high chlorine residuals and high alkalinity concentrations are maintained simultaneously.*



Brash, checked wood.

Typically the wood takes on a white or bleached appearance, and the surface becomes fibrillated. This attack is restricted to the surface of the wood and the strength of the unaffected area is not impaired. However, severe thinning of the wood will occur wherever cascading water has an opportunity to wash away the surface fibers. In serious cases, the loosened fibers have caused plugging of the screens and tubes, and have served as focal points for corrosion at areas where the fibers accumulate in heat exchange equipment.

Chemical attack most frequently occurs in the fill section and flooded portions of the tower where water contact is continuous. However, it will occur also in those areas where alternately wet and dry conditions develop—such as on the air intake louvers and other exterior surfaces. Chemical attack occurs also in the warm, moist areas of the plenum chamber of the tower caused by chlorine vapors and entrainment of droplets of tower water.

Biological Attack

Biological attack of cooling tower wood can be divided into two basic types . . . soft or surface rot and internal decay. These two types of deterioration are characterized by the effect they produce. *In general, biological attack is insidious. It can proceed relatively unnoticed for long periods of time and then can manifest itself suddenly . . . and disastrously.*

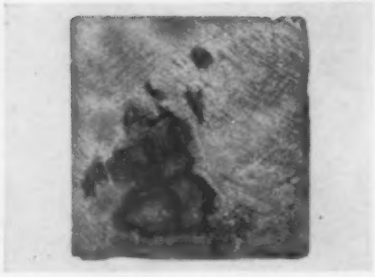
The organisms that are responsible for attack of cooling tower wood are those that can utilize cellulose as their source of carbon in their growth and development. Degradation of the cellulose is accomplished by the secretion of enzymes which convert the cellulose into compounds that can be absorbed by the organisms. The attack tends to deplete the cellulose content of the wood and leaves a residue rich in lignin. Characteristically, the wood becomes dark in color and loses much of its strength. The wood also may become brash, soft, punky, cross-checked or fibrillated. The principal cellulolytic organisms isolated from cooling tower wood are primarily fungi, which include the classical wood destroyers (Basidiomycetes), and members of Fungi Imperfecti. However, bacterial organisms that exhibit cellulolytic properties also have been isolated but their exact role in cooling tower wood deterioration is yet to be determined. The wood destroying organisms are common air and water borne contaminants, and are widely distributed in nature.

The classical *internal decay* is restricted generally to the plenum areas of the tower, such as the cell partitions, doors, drift eliminators, decks, fan housing and supports. It is the more insidious of the two types of biological attack. It is characterized externally by an apparently sound piece of wood, which upon breaking shows severe in-

ternal decay. Because the decay is internal, it is difficult to detect in its early stages. Rarely is internal decay found in the flooded portions of the tower such as the fill section. In these sections, the wood is saturated completely with water which excludes oxygen from the interior of the wood. The absence of oxygen limits the growth and development of these organisms.

Soft or surface rot is found predominantly in the flooded sections of the tower but also occurs in the plenum areas. The water flowing over the wood surfaces in the flooded portions contains enough oxygen to support growth. Surface rot is detected more readily, and its effect is less severe than internal decay.

In addition to oxygen—moisture and temperature have a marked bearing. Locations where the moisture content of the wood range between 20 and 27% and temperatures range between 88 and 105 F, usually permit optimum growth and development of the organisms.



Internal biological attack.

Chemical deterioration as manifested by delignification can be controlled readily by restricting the pH and chlorine concentration of the circulating water. It is advisable to restrict the pH below 8.0 and preferably in the range of 6.0-7.0. In this range, the alkaline salts will be at a low level, the rate of leaching of extractives will be slower and the adverse effect of chlorine will be lower. It is also advisable to restrict the free chlorine residual to no more than 1.0 ppm, or preferably lower. Intermittent chlorination is preferred over continuous chlorination, since the latter even at concentrations less than 1.0 ppm tends to promote more rapid deterioration of tower wood.

Biological deterioration of the surface type, particularly in the flooded portions of the tower, can be greatly minimized by the same factors which minimize chemical attack. There is ample evidence that chemical surface attack renders the wood more susceptible to biological surface attack. In addition to the control of pH and the judicious use of chlorine, the supplemental periodic addition of non-oxidizing biocides to the circulating water to control the causal organisms will be of material benefit.

The control of biological deterioration in the plenum areas of the tower is considerably more complicated, primarily because of the internal decay which is prevalent in these areas. *This type attack can proceed relatively unnoticed for long periods of time and then can manifest itself suddenly—and disastrously.* This statement is repeated to emphasize the insidious nature of this type attack. Thorough inspections will not always disclose the extent or presence of incipient decay. Detection is made generally only after extensive damage has been done. Infected members should be removed and replaced preferably with 'treated' lumber. Because of the random nature of the attack, and the fact that only the most seriously affected areas will be discovered and replaced, subsequent discovery of more areas of infected lumber will be uncovered with time, and maintenance and repair costs will mount.

The existing methods of control of biological deterioration in the plenum areas of operating towers involves spraying the lumber with preservatives that are toxic to the causal organisms. Impregnation of the wood relies on diffusion of the toxicants into the wood. Whereas diffusion of the toxicants through the ends of the wood members is good, diffusion across the grain is not very great, often limited to penetration of the outer ⅛″ to ¼″ of the member. In large members, where the internal rot is deeply seated, the toxicant will not reach the infected area and growth of the organisms can continue. Accordingly, at best the procedure of spraying the plenum areas of the tower can only help in containing the infection. *Because of this limitation it is essential that the corrective procedure be applied before the tower is seriously infected.* Therefore, for maximum benefit in minimizing biological attack of the internal type, spraying of the plenum areas of the tower should be done before serious infection has developed. The spray procedure should be adopted and viewed as preventive maintenance.

In order that serious attack be avoided, periodic examination of the tower should be augmented by submitting wood samples to a qualified microbiological laboratory. Studies of the wood can be made which will show the incidence of fungi on the surfaces and interior sections of the wood and whether cellulolytic organisms were or are present. The natural resistance of the wood should be checked to determine whether it has diminished to a point where it is no longer effective against microbiological attack. These studies can serve as a basis for determining when to initiate the preventive spraying program.

TOWER LIFE

Physical and Other Factors

One of the major physical factors is the effect of temperature upon wood. Wood technologists have long recognized that high temperatures have an adverse effect on wood. It is known that continuous exposure to high temperatures will produce gross changes in anatomical structure and will accelerate loss in wood substance. These resultant effects will weaken the wood and predispose it to biological attack particularly in the plenum areas of the tower.

There are other factors which also have a bearing on the deterioration of tower wood. For example, areas adjacent to iron nails and other iron hardware usually deteriorate at an accelerated rate. These areas invariably lose much of their strength and the wood will crumble easily in the fingers. Slime and algae growths and deposition of dust and oil can all aid the growth and development of the soft rot organisms.

Control of Wood Deterioration

While the subject of wood deterioration under cooling tower operating conditions is far from being completely understood, a considerably better understanding of the process has been gained during the last few years. With this understanding, a comprehensive program can be outlined which, if followed, will assure a minimum of attack and longer tower life.

Betz Laboratories maintain a well equipped microbiological laboratory, staffed by microbiologists with an extensive background in the field of cooling tower wood deterioration. We will be pleased to make our facilities and services available for the study of your cooling tower problems. For more details on the care and maintenance of cooling tower wood deterioration, write for Bulletin 605.

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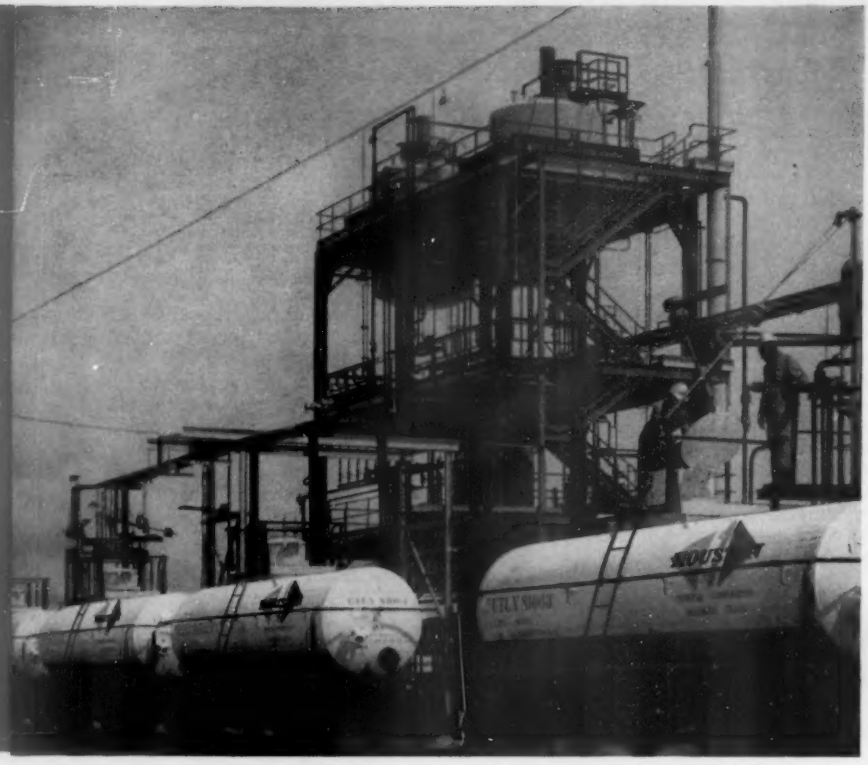
THE NEWS FROM TEXAS IS BIG (naturally!)



news! The first shipment of TEL from Houston's new Beaumont, Texas, plant has **already been made.** The plant is on stream well ahead of schedule. And well below cost estimates.

news! The originally estimated capacity of 60,000,000 pounds per year has been beefed up to 100,000,000 pounds.

news! The oil refining industry now has a third, and important source of supply for lead anti-knock additives. Your inquiries are invited.

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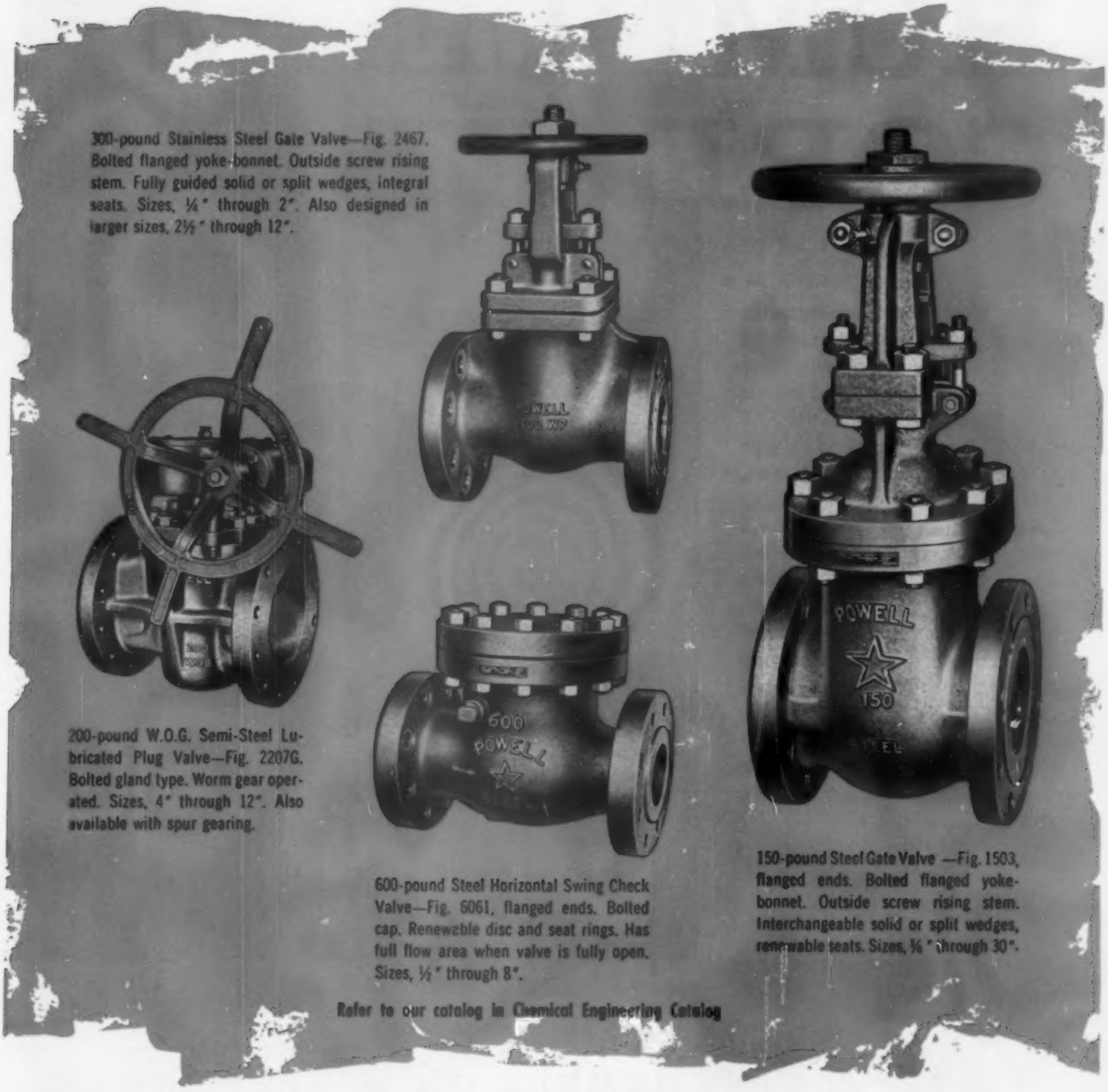

300-pound Stainless Steel Gate Valve—Fig. 2467. Bolted flanged yoke-bonnet. Outside screw rising stem. Fully guided solid or split wedges, integral seats. Sizes, ¼" through 2". Also designed in larger sizes, 2½" through 12".

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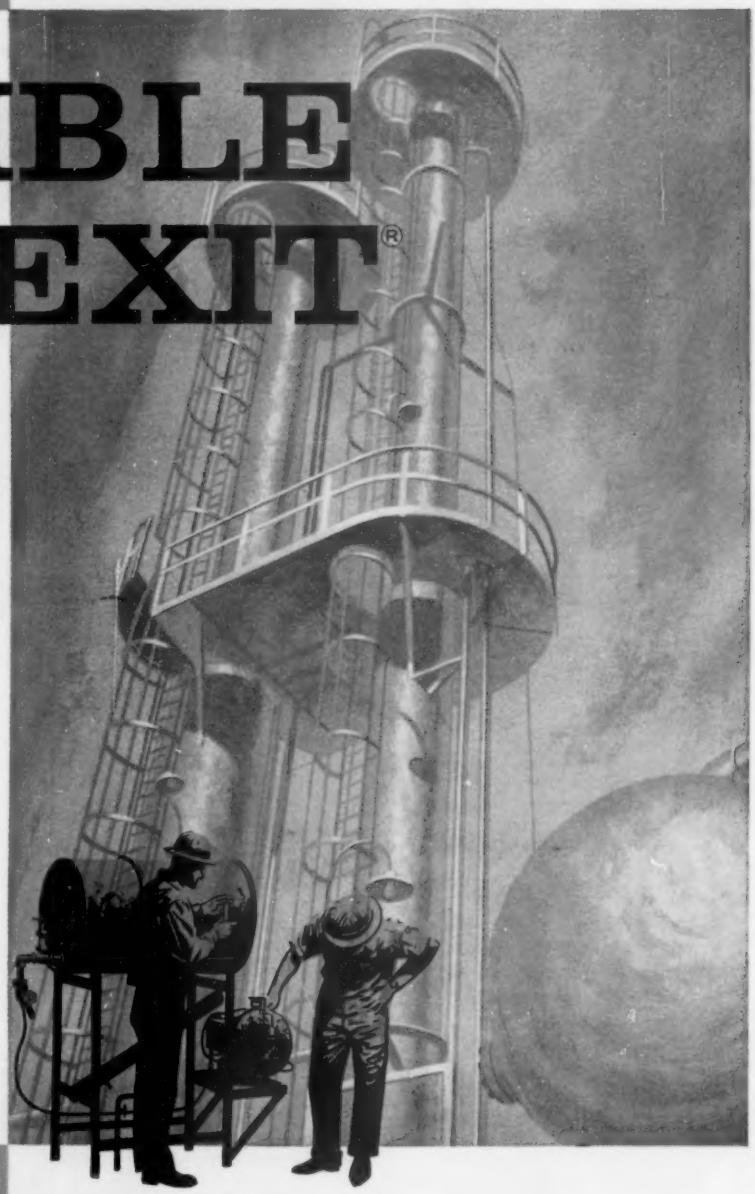

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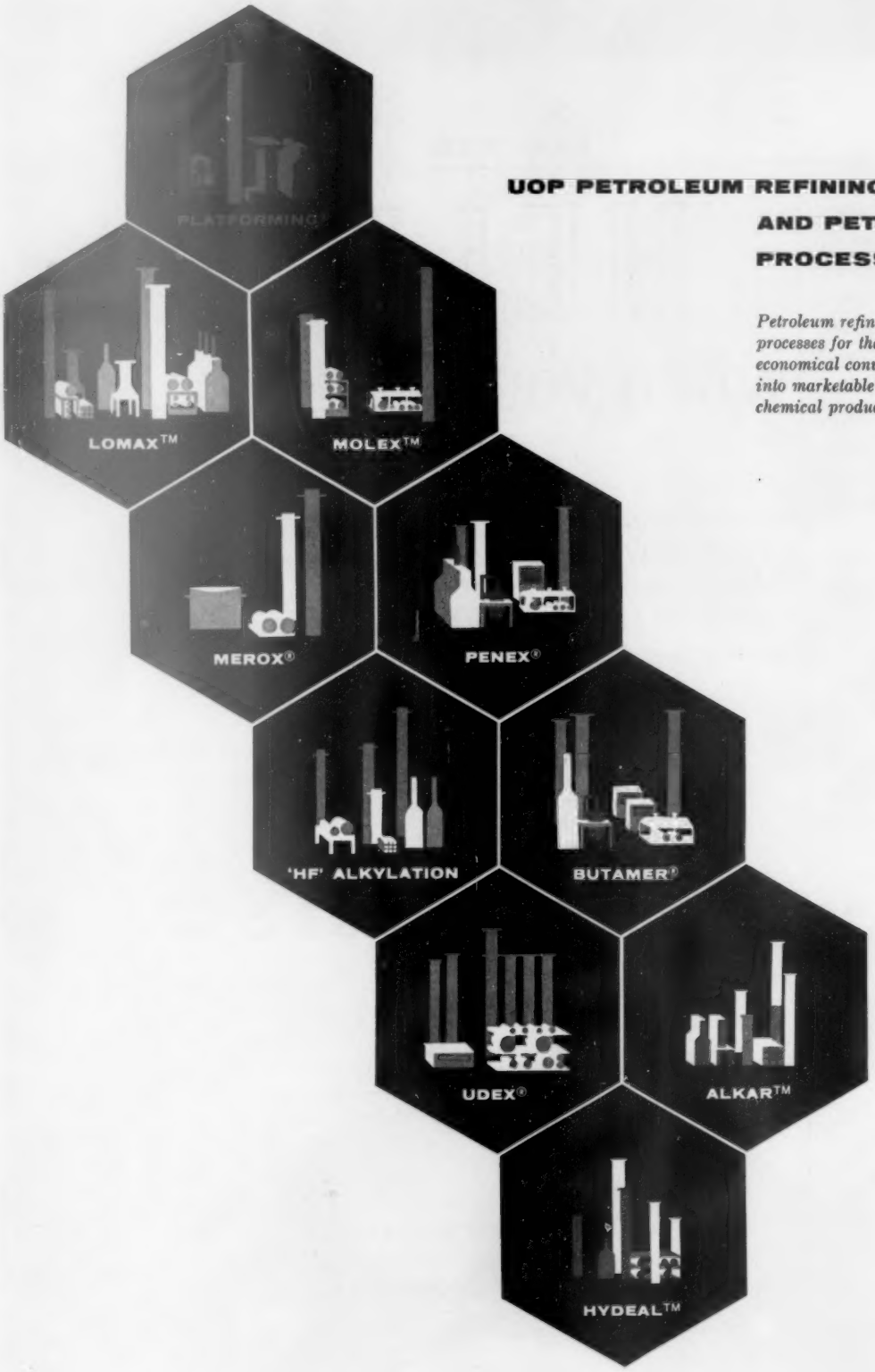

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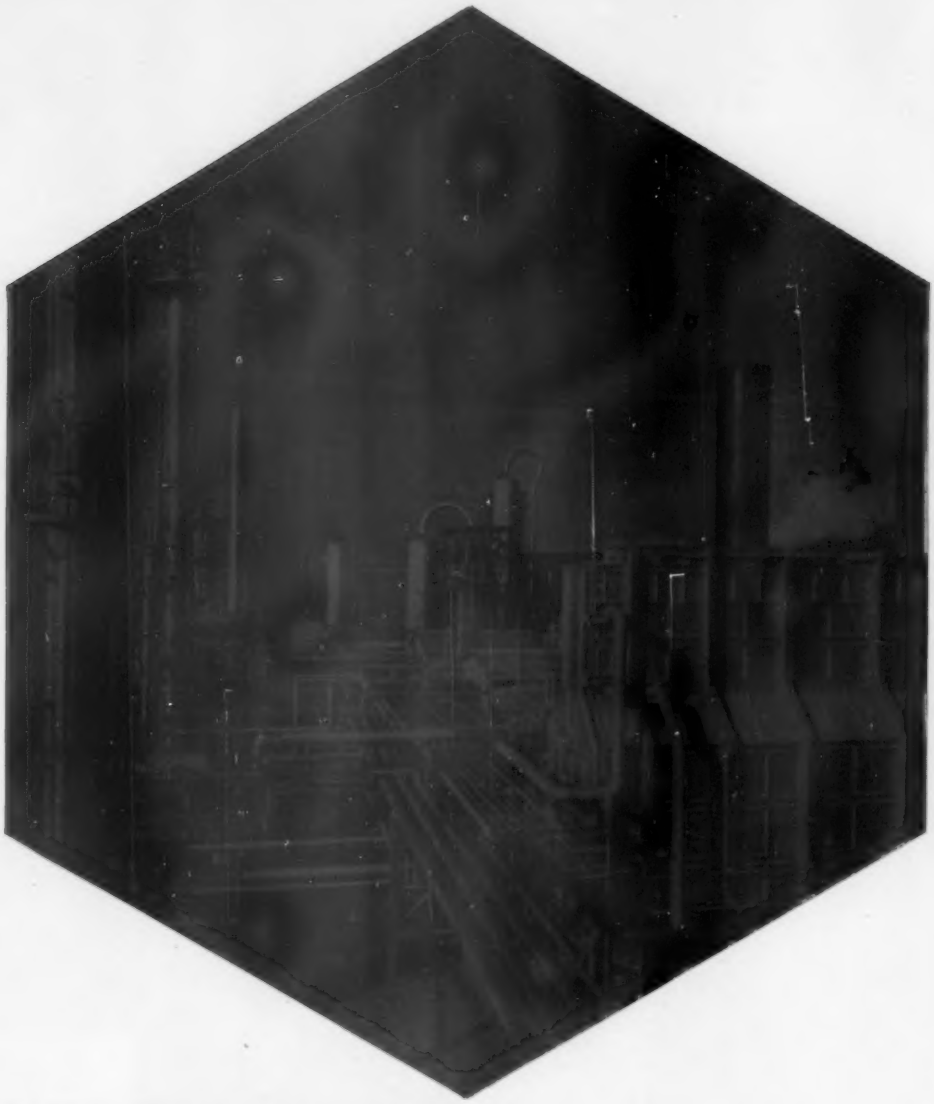

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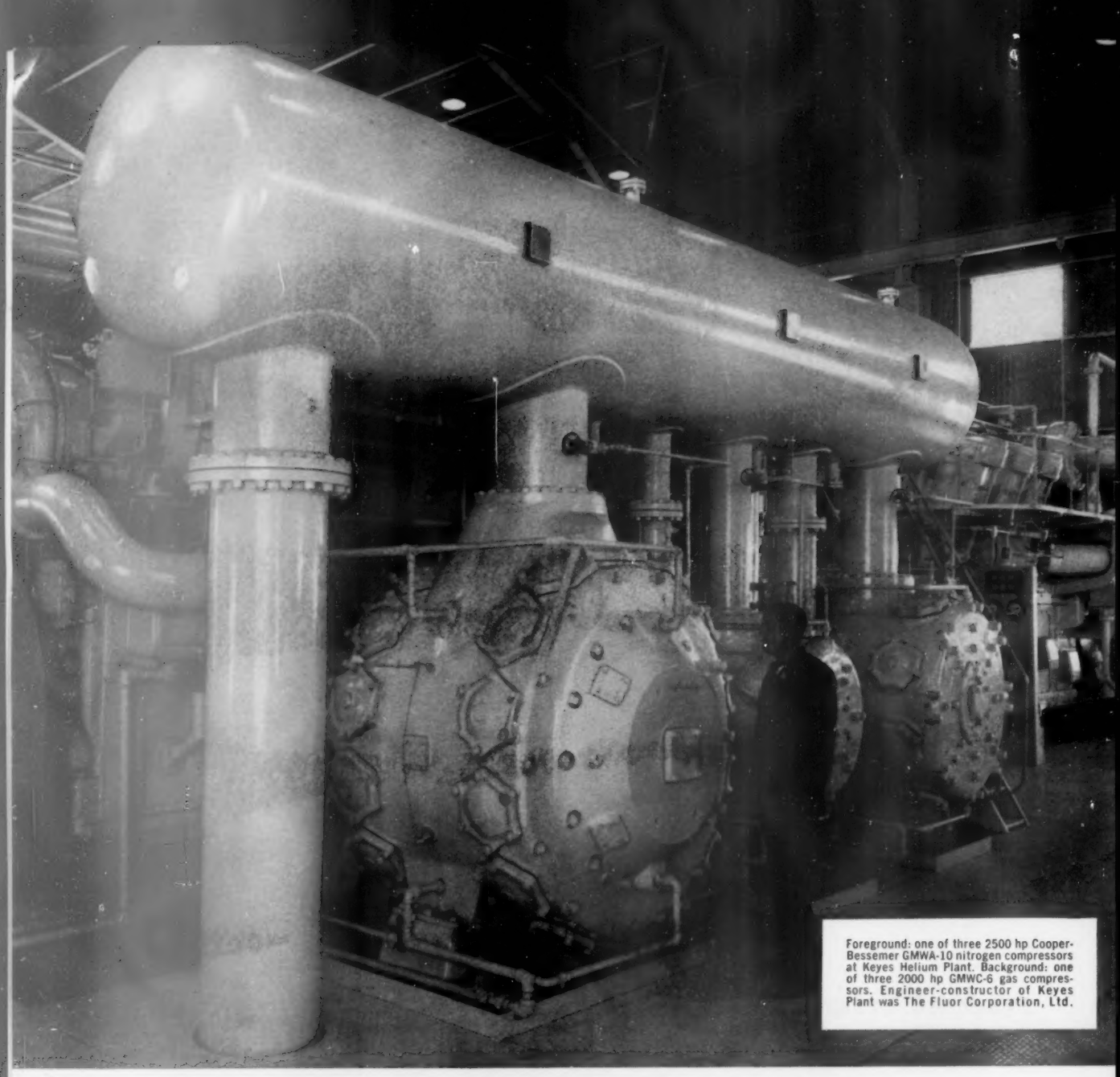

Foreground: one of three 2500 hp Cooper-Bessemer GMWA-10 nitrogen compressors at Keyes Helium Plant. Background: one of three 2000 hp GMWC-6 gas compressors. Engineer-constructor of Keyes Plant was The Fluor Corporation, Ltd.

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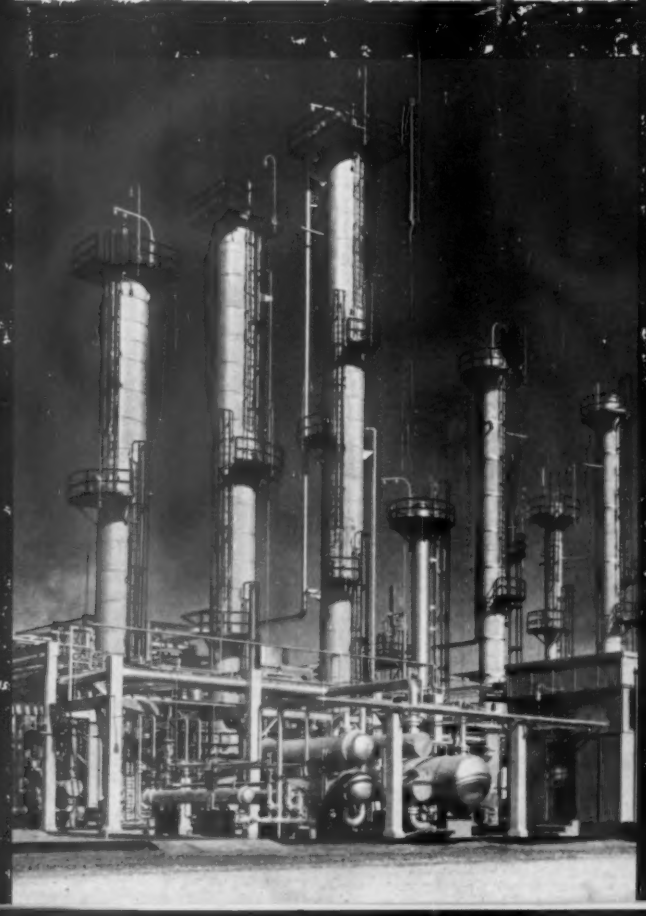

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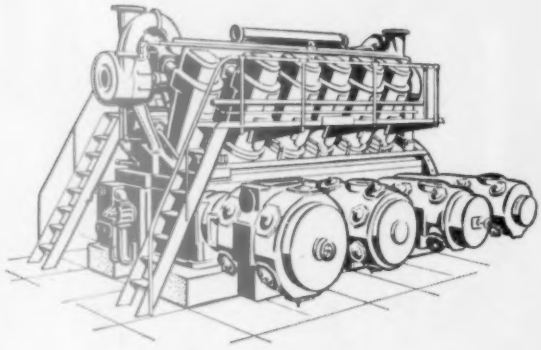

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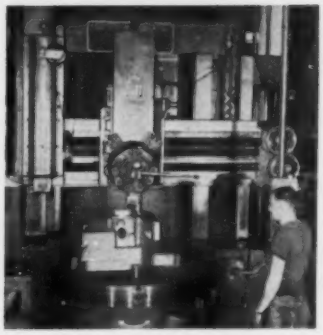
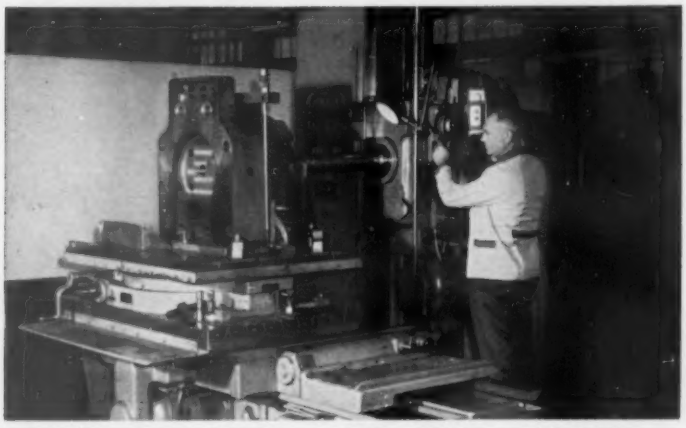


One of the large turret lathes used for roughing and precision-finishing operations on engine cylinders.



This boring-milling machine with positive-stop automatic positioning can machine power cylinder heads to tolerances of a ten-thousandth inch, permitting interchangeability without additional fitting.

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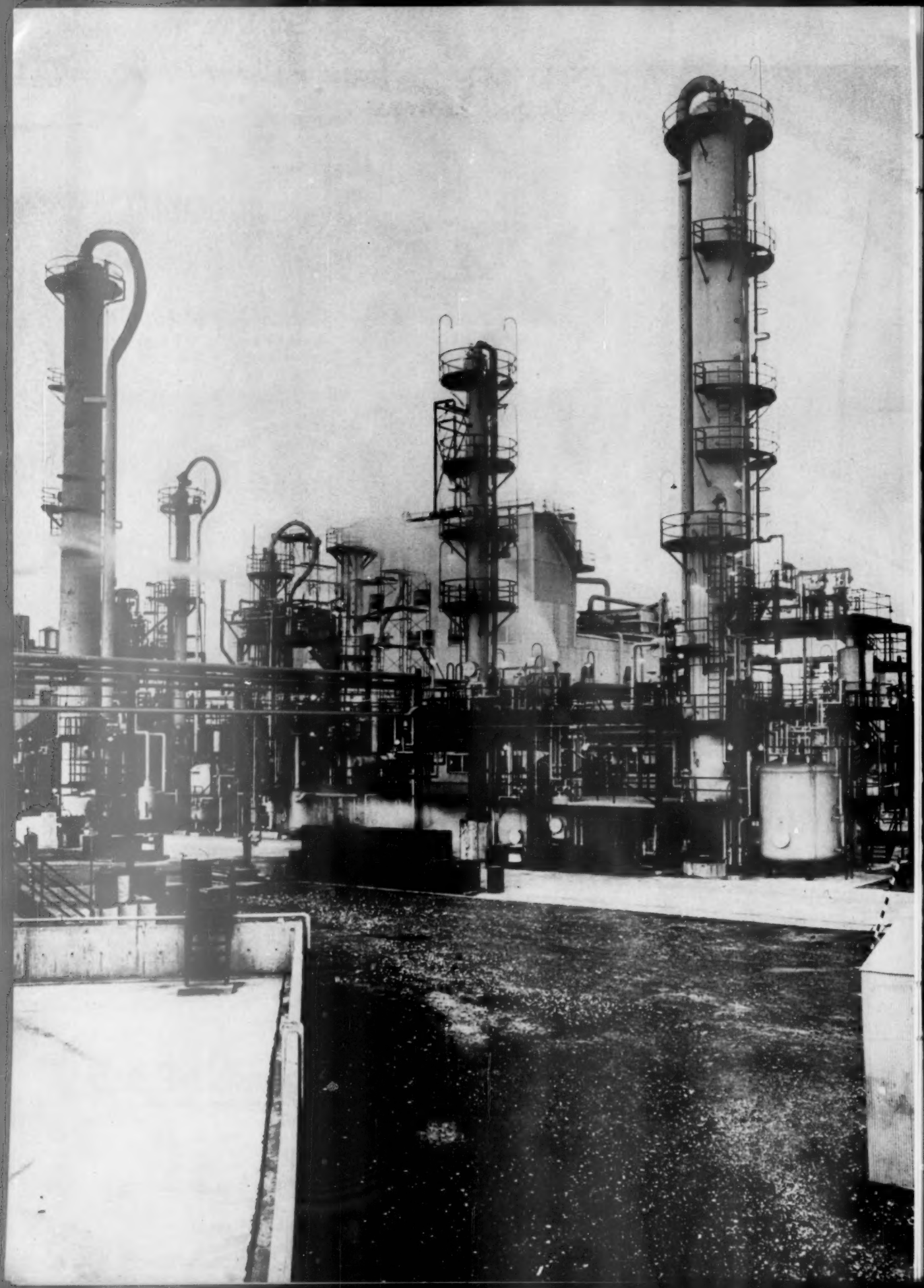

by Peter W. Sherwood

New Feedstocks to Help Boost Petrochem Profits

The petrochemical industry is turning to new hydrocarbon feedstocks in its effort to increase profits by diversification and lowered production costs.

Much developmental activity has centered on displacement of one petroleum-based raw material by another, usually of lower unit cost. It has borne particular fruit in such widely scattered areas as synthesis of acrylonitrile, caprolactam, phenol and methacrylates.

This article will trace some of these shifts in hydrocarbon base being opened up to petro synthesis by new technology. It will also discuss economic factors at work in these far-reaching developments.

Five main areas will be covered — end use position of acetylene, benzene, higher aromatics and olefins, plus interchange of miscellaneous organic feedstocks of the petrochemicals industry.

Growth of the petrochemicals industry itself has been a prime example of substituting new raw materials for conventional sources of chemical synthesis. The last 20 years have seen this shift from conventional sources to petroleum raw materials:

Material	Conventional source	% of production from petroleum sources in 1959 (USA data)
Acetylene	Calcium carbide	18
Benzene	Coking operations	60
Toluene	Coking operations	89
Sulfur	Frasch mining	11

Within the petrochemicals industry, development may be concerned either with hydrocarbon source or with other (usually inorganic) chemicals which enter into the petrochemical reaction. Emphasis in earlier years has been on the latter type of raw material, for example:

Product	Raw Materials in earlier process	Raw materials in more recent process
Ethylene oxide	Ethylene, chlorine, lime	Ethylene, air or oxygen
Phenol	Benzene, sulfuric acid caustic soda	1. Benzene, chlorine, caustic soda 2. Benzene, air, steam (in the Raschig process, an indirect method; actually there is also some HCl consumption) 3. Benzene, propylene air (cumene hydroperoxide route; yields by-product acetone.)

Currently, however, there is a strong movement toward new petroleum based raw materials. It is influenced by developments in chemical technology and by changes in availability, demand and price pattern of various feedstocks.

Shifts in Acetylene

Ethylene, as a widely available merchant commodity, has a well-established price range. In 98% purity, it is available from about 5 cents per lb in the Gulf Coast area to 6 cents per lb at producing sites in the Northeast. This allows an estimated 18 to 20% return on investment (after taxes) in a 200,000,000 to 300,000,000 lb per year plant operated at capacity.

By contrast, there is no clearly defined market price for acetylene, except in the few centers (notably Ashtabula, Ohio) where the material is available, on a merchant basis, in very large volume.

Some 75% of 1960 capacity and 82% of production was derived from calcium carbide. Investment in carbide-based acetylene generating plants is relatively low and raw materials price is strongly controlling. In calcium carbide-pro-

Caprolactam is manufactured from phenol at this plant operated by Allied Chemicals at Hopewell, Va.

ducing centers (usually low-cost power areas), acetylene may be typically costed into production at 12.5 to 13.5 cents per lb.

The picture becomes less clear in dealing with methane-based acetylene plants. With one minor exception, all existing U. S. units involve oxidative pyrolysis of methane, and their economics are crucially influenced by value applied to by-product synthesis gas.

Du Pont announced in March 1961 an acetylene plant in which an improved electric arc will serve as heat source for hydrocarbon pyrolysis. The process, which reportedly consumes less power than the electric arc acetylene process operated at Huels, Germany, will be basis of a 50,000,000-lb-per-year plant now under construction at Montague, Mich.

There are several acetylene-from-methane processes offered to the industry today (BASF-Chemico, SBA-Kellogg, Montecatini-Braun, Eastman-Kodak two-stage, Phillips two-stage, etc.) and available economics suggest remarkable similarity in production cost (8 to 9 cents per lb) and investment.

Greatest amount of debate centers around fair return on capital. What is "fair" return? Should one consider only equity capital or total investment as basis for the return? At what percent of capacity must the desired return be earned, etc.?

Acetylene plants, because of their limitations in locality and end use, are clearly subject to obsolescence, a pressure particularly pronounced because of the potential for obtaining nearly all acetylene-derived chemicals by alternative routes. Consequently, a fairly high return is generally required. The following acetylene prices are typical in a 50,000,000 lb per year Gulf Coast plant, operated at 90% service factor [12,13]:

Return A/T % per year	Acetylene sales price, ¢/lb
9.5	11
13.0	12
16.0	13
20.0	14.1

Thus, acetylene at a fair price of 12 to 14 cents per lb must compete with ethylene at about 5 to 5.5 cents per lb. Despite this divergence, there is currently a wave of expansion in acetylene capacity.

Announced projects are expected to raise carbide-based acetylene capacity from one billion lb per year in 1959 to 1.1 billion lb per year in 1963, while hydrocarbon-based acetylene capacity during the same period will spurt from 300,000,000 to 700,000,000 lb per year.

Of the 400,000,000 lb per year increase in hydrocarbon-based acetylene capacity, some 50,000,000 is accounted for by Du Pont's new unit at Montague, Mich. Its effect will be to back out carbide-based acetylene capacity.

For the intended end use of this plant, manufacture of neoprene, acetylene at present is the only suitable hydrocarbon base. Future neoprene growth will therefore continue to rely on acetylene. However, some developmental rubbers, notably halogenated butyl rubber, have certain similarity with neoprene and may eventually offer competition in this field.

Other new plants for petrochemical acetylene are being built by Dow-Badische, Union Carbide, Monochem, Diamond Alkali and Tenneco. End use of these plants will be principally in manufacture of vinyl chloride, vinyl acetate and acrylates. Biggest consumer by all odds will be vinyl chloride.

In this field very strong competition exists with ethylene-based processes. For the last several years, amount of vinyl chloride obtained from each of these processes has see-sawed between 40 and 60% of total production.

Role of Hydrogen Chloride

A controlling consideration in choice of acetylene vs ethylene in production of vinyl chloride is role of hydrogen chloride in the manufacturing cycle. Acetylene-based synthesis consumes one mole HCl per mole vinyl chloride, while ethylene-based processes result in net formation of one mole HCl per mole vinyl chloride.

Where there are adequate means for utilizing by-product HCl, this balance speaks clearly in favor of the ethylene-based route. However, if HCl is in surplus economics become more complex. Here the ethylene route to vinyl chloride must be charged with one mole chlorine per mole product, twice the chlorine consumption called for by the acetylene route. This is in addition to differences in investment and operating costs for the two processes.

In today's technology, HCl is a surplus commodity in many locations. Its only large-scale end uses are in muriatic acid and production of vinyl chloride (from acetylene), chloroprene (for neoprene), ethyl chloride (from ethylene or ethanol) and methyl chloride. On the other hand, HCl is generated in any number of chlorination processes, including production of allyl chloride, vinyl chloride (ethylene-based synthesis), perchloroethylene, chlorinated methanes, chlorobenzene, etc.

With rapid growth of chlorinated organics, availability of by-product HCl has also increased. According to a recent study,[1] chlorination processes accounted for 74% of total U.S. HCl output in 1960 vs 66% in 1958. During the same years, total HCl production rose from 826,000 to 1,040,000 short tons (100% basis). Increasing share provided by the by-product of chlorination results in corresponding cutback in HCl genera-

tion by hydrogen-chlorine burning and by salt-sulfuric acid processes.

The few petrochemical processes which consume hydrogen chloride on a large scale are, of course, an attractive way to dispose of this by-product of chlorination. Above all in this category, are synthesis of chloroprene and of ethyl chloride. Acetylene-based vinyl chloride synthesis also offers a means for HCl disposal, and several such units are operated in tandem with chlorination plants or with ethylene-based vinyl chlorine installations in which HCl is formed in the course of dehydrochlorination.

However, disposal of HCl by reaction with acetylene has definite economic shortcomings relating to high cost of acetylene and ability to produce vinyl chloride from a substantially lower-cost raw material. Accordingly, considerable effort is underway to find other means for utilization of by-product HCl. Its outcome may influence long-range competition between the different raw materials bases.

Several attempts have been made to convert by-product HCl to chlorine by partial combustion or electrolysis. However, they are not commercial today because of technical and corrosion difficulties and high capital cost.

An alternative but related approach involves reaction of HCl with oxygen and a hydrocarbon to yield the corresponding chlorinated hydrocarbon. In a pilot plant now being operated at Orange, Tex.,[2] this process serves for chlorination of methane to yield 40% carbon tetrachloride, 40% chloroform, 15% methylene chloride and 5% methyl chloride.

In another related process of commercial potential, ethylene is reacted with HCl and oxygen to yield ethylene dichloride which may then serve as part of feed to a vinyl chloride plant.

In known versions of various HCl-utilizing chlorination processes, copper chloride is basic catalyst. In a process patented by Johnson and Cherniavsky,[3] a gaseous mixture of oxygen, hydrogen chloride and ethylene in the mole ratio 1:303:1.65 is contacted with a fluidized finely divided catalyst consisting of alumina impregnated with copper chloride, at the rate of 0.5 lb of the charge mixture per pound catalyst per hour in a reactor operated at 285 C and atmospheric pressure. Gaseous effluent from the reactor contains 16.2 mol % organic chlorides consisting essentially of EDC, plus 72 mol % water and 8.8% HCl. Overall yield is 90.7% on ethylene and 97.7% on HCl.

Acrylonitrile Production

In manufacture of acrylonitrile, the pendulum is now beginning to swing away again from acetylene-based routes. Until about 10 years ago, all U. S. production was based on the indirect, cumbersome synthesis via ethylene oxide. With rapid expansion of acrylonitrile demand during the 1950's, this route was completely obsoleted by the direct synthesis of acrylonitrile from acetylene and hydrogen cyanide (possible exception: a 70,000,000-lb-per-year plant operated by Union Carbide).

Today syntheses based on propylene and acetaldehyde are entering the picture. The propylene approach shows especially good commercial promise and will soon constitute 90,000,000 lb capacity out of a total 445,000,000 lb per year. In light of current acrylo consumption (220,000,000 lb in 1960), this is significant overcapacity. It was largely the cause of a mid-year 1961 price drop from 23 to 14.5 cents per lb (listed) and from approximately 16 to 14.5 cents (contract).

First plant for production of acrylonitrile from propylene, ammonia and air was put on-stream by Sohio Chemical Co. in 1960. Its 40,000,000 lb per year capacity compares with an acetylene-based acrylo capacity of 355,000,000 lb per year in operation during the same year. The new approach will, however, be responsible for much acrylonitrile capacity to be built in the future.

Du Pont will use a different propylene-based process in a 50,000,000 lb per year plant being built at Beaumont, Tex. Sohio's ammoxidation is reportedly planned for use by two Japanese producers (Asahi Chemical and Mitsubishi Chemical). In England, Distillers Co., Ltd. will use its own process for ammoxidation of propylene.

Distillers has two approaches to acrylonitrile production — two-stage conversion via acrolein and, more recently, a single-stage process in which oxides of molybdenum and cobalt serve as catalyst.

Sohio's catalyst is reported to be concentrated (approximately 50 to 60%) bismuth phosphomolybdate on silica. Idol[4] calls for use of air as oxidizing agent. Preferred oxygen-to-propylene ratio is between 1:1 and 2:1. Ratio of ammonia to propylene is between 1 and 2.5:1. About one volume steam per volume propylene is added as diluent and for improved yield. Operating conditions are 425 to 510 C, 2 to 3 atm total pressure, 25 sec contact time.

In this operating range, percent conversion to acrylonitrile is reported up to 52.8% (on carbon basis). Principal by-product is acetonitrile. Hydrogen cyanide is also formed and may be recovered or recycled.

Veatch[5] reports the plant employs a fluid-bed catalyst and the hydrocarbon feed may contain as little as 40% propylene. Significant economic advantages over the conventional process are claimed. Thus, investment in Sohio's process is

Alkylation of benzene to produce ethyl benzene is carried out at Koppers Co. plant at Port Arthur, Texas.

reported[6] at $340 per annual ton vs $840 to $1200 for plants based on acetylene and hydrogen cyanide. Raw material cost is of the order of $135, perhaps $100 below those for the conventional process. However, the latter's costs are very sensitive to capital charges applied against raw materials acetylene and hydrogencyanide.

Indications are Du Pont's new acrylonitrile plant employs a fluid-bed reaction between nitric oxide and propylene, effectively catalyzed by silver on silica. In one version of the process, operating temperature is near 500 C and space velocity is in the range 300 to 500 hr^{-1}. Feed gas contains NO and propylene in approximately stoichiometric ratio, and is highly diluted by nitrogen. Significant information on performance is not yet available.

A completely different approach to acrylonitrile synthesis, which also breaks away from acetylene as raw material, is reaction between acetaldehyde and hydrogen cyanide. This method, developed at Germany's Knapsack-Griesheim, may take on special significance in light of new process of acetaldehyde synthesis by direct oxidation of ethylene. This will be described in more detail later.

Key to the long-sought synthesis of acrylonitrile from acetaldehyde and hydrogen cyanide is use of phosphoric acid as dehydrating agent in the second, dehydration stage. First step is condensation of acetaldehyde and hydrogen cyanide in neutral medium to yield lactonitrile. This intermediate is mixed with phosphoric acid and the mixture is injected into a stream of combustion gases, to be dehydrated to acrylonitrile at 600 C.

For this process, Sennewald[14] claims yield on both raw materials which exceeds the acetylene-HCN route by 10 to 15%. (At a current price of 9 cents per lb acetaldehyde, a 15% improvement in yield provides hydrocarbon break-even with 13-cent acetylene.) Furthermore, the product can be readily purified to meet stringent specifications of fiber-grade acrylonitrile (less than 0.0005% divinyl acetylene, below 0.12 methyl vinyl ketone). This degree of purity is difficult to achieve in the conventional, acetylene-based process.

Shifts in Benzene

During the years 1960-61, both the supply and end use situation for benzene appears to have entered a new era.

From the short-range point of view, surely the most important development has been commercial introduction of hydrodealkylation. It permits production of benzene from toluene, whose availability from petroleum fractions exceeds that of benzene by a factor of about 5:1.

Adoption of toluene hydrodealkylation has been extremely rapid. First unit of this type came on stream in late 1960. By March 1961, three benzene units were onstream, four under construction and additional plants were in the planning stage and are expected to raise total capacity of toluene hydrodealkylation plants to 120,000,000 gal per year benzene by mid-1962.

All told, U. S. benzene output will be some 530,000,000 gal in 1961. Total year-end capacity in late 1961 is estimated at 740,000,000 gal per year, and it may reach 916,000,000 gal by year-end 1962.

Incentive for these plants stems from several factors: First, a substantially higher demand exists for benzene than for toluene. The 1960 consumption of benzene exceeded 500,000,000 gal vs 255,000,000 gal for toluene. Second, the market for chemical-grade toluene, currently priced at 25 cents per gal, freight equalized, is even substantially lower.

While a firm price for the large volume of toluene blended into gasoline is not posted, a typical value is considered to be in the range 13 to 16 cents per gal. By contrast, benzene brought 34 cents per gal in early 1961 and dropped to 31 cents in July under the influence of impending overcapacity.

At this differential, a good payout can be obtained on hydrodealkylation plants, which reportedly obtain benzene in yields ranging from 93 to 96% of theory on toluene, and have a conversion cost of 2 to 5 cents per gal.

While hydrodealkylation appears to have broken any foreseeable bottleneck in benzene supply, several recent developments offer a new raw materials base for production of petrochemicals traditionally produced from benzene. Of foremost importance here are direct recovery of ethyl benzene from C_8 reformate fractions, commercial development of toluene-based processes for the manufacture of phenol and caprolactam, synthesis of adipic acid and caprolactam directly from cyclohexane and synthesis of maleic anhydride from butene-2. The new routes to phenol, caprolactam and maleic anhydride are only now in process of commercialization.

These developments touch on nearly all major areas of benzene consumption. In 1959, ethyl benzene accounted for 45% of benzene consumption, phenol for 22.1%, nylon intermediates (adipic acid and caprolactam) for 7.4% and maleic anhydride for 2.7%.

Production of Phenol

Manufacture of phenol is today practiced by four commercial routes — sulfonation-caustic fusion, chlorination-caustic hydrolysis, oxychlorination-steam hydrolysis (Raschig) and cumene hydroperoxide. In all these techniques, benzene is the starting material. First deviation from this raw materials base will come with the commercial start-up (probably in mid-1962) of a toluene-based phenol plant now being built by Dow Chemical Co. at Kalma, Wash., with capacity of 36,000,000 lb per year. The same route will serve at plants now under construction at Tilbury Island, B. C., by Dow Chemical of Canada and at Rotterdam, Holland, by a joint subsidiary of Staatsmijnen in Limburg and Dow Chemie AG.

This synthesis of phenol is first outlet which will bring benzoic acid into the ranks of heavy organic chemicals. Almost simultaneously, another promising process is being commercialized in which benzoic acid is converted to caprolactam. Here again, a shift is observed in raw materials position. In conventional operation, caprolactam is produced from benzene or from cyclohexane via cyclohexanone oxime.

In the new method of caprolactam synthesis, benzoic acid is hydrogenated to hexahydrobenzoic acid. This is then converted to caprolactam by action of nitrosyl sulfuric acid in the presence of concentrated sulfuric acid or oleum. Per-pass conversion of hexahydrobenzoic acid in this reaction is found to be 61%; ultimate yield of caprolactam is reported at 90% of theory.[9] The process, developed by Snia Viscosa, is reported to be basis for caprolactam facilities now under construction by Snia Viscosa in Italy, Allied Chemical in the United States and Courtaulds Ltd. in England.

Another competition to benzene-using processes appears in production of maleic anhydride by partial oxidation of butene-2. A 30,000,000 lb per year plant using this process is now under construction for Petro-Tex Corp., and in April 1961 Britain's ICI announced a 20,000,000-lb-per-year maleic plant, also based on butenes. Benzene-based maleic anhydride plants will provide a capacity of 210,000,000 lb by late 1961.

Indications are that Petro-Tex carries out its butene oxidation over a modified benzene oxidation catalyst. For example, oxidation of butene-2 over a mixed phosphomolybdate-phosphovanadate (Mo:V:p = 9:3:1) on silica gel showed a maleic yield as high as 27% of theory.[8] Significantly, some related work showed little difference in the oxidation behavior of butene-1 and butene-2 thus indicating the possibility of using a mixed feed.

Cyclohexane as alternative raw material to benzene has become of principal importance in production of cyclohexanol and cyclohexanone—intermediates in production of adipic acid and caprolactam. In this application, cyclohexane and benzene have been competitive throughout the 1950's, with the current swing favoring the

cyclohexane route. Use of benzene leads via phenol which is then hydrogenated to cyclohexanol. Cyclohexane, on the other hand, is air-oxidized in the liquid phase to yield cyclohexanone-cyclohexanol mixtures.[7]

Co-products which occur in the crude oxidation product are largely convertible to adipic acid (by nitric acid oxidation), so they do not constitute a loss. However, in the synthesis of caprolactam, cyclohexanone must be recovered in quite pure form, and side reactions in the oxidation stage constitute a loss.

For these reasons, the phenol route with its smooth conversion to cyclohexanol and to cyclohexanone has retained a much stronger position in the caprolactam field than in adipic acid production. However, this too is changing. Cyclohexane will be basis of caprolactam production by Dow-Badische. A different, cyclohexane-based route to caprolactam serves at a plant now being built by Du Pont.

Trends in Higher Aromatics

Key higher aromatics of interest here are naphthalene and paraxylene.

Hydrodelkylation has created a new source of naphthalene in petroleum fractions. This will bring first permanent relief to the periodic raw materials shortages which have plagued naphthalene users — principally phthalic anhydride manufacturers — since the early 1950's.

The first three hydrodealkylation units for naphthalene production will come onstream in 1961. Operated by Ashland Oil (already delivering), Sun Oil and a joint venture of Tidewater Oil and Collier Carbon, these plants will provide a combined naphthalene production capacity of 300,000,000 lbs per year. Bear in mind that U. S. demand for naphthalene was 580,000,000 lbs in 1960, and is expected to reach 750,000,000 lbs in 1965. Installed naphthalene recovery capacity from coal tar sources is 550,000,000 lb per year but coal tar supply has been far short meeting demand for naphthalene.

Naphthalene content of petroleum fractions is usually too low to justify recovery. The bottleneck was broken with introduction of hydrodealkylation techniques (in proprietary methods of several engineering and petroleum companies) which are capable of demethanating much more plentiful methyl naphthalenes to naphthalene.

During the period of recurring naphthalene shortage, ortho-xylene has frequently been viewed in the United States as alternative raw material for phthalic anhydride production. Actually, only two U. S. producers (Oronite Chemical Co. and Amoco Chemical Co.) have drawn on this source. Two other plants have availed themselves of ortho-xylene as alternative feed-stock only during periods of acute naphthalene shortage. In all, some 14% of phthalic anhydride output is based on an o-xylene raw materials base. In Japan and Italy, however, this hydrocarbon constitutes a substantially larger share of the total feedstock for phthalic anhydride production.

Para-xylene's importance hinges almost exclusively on its role as intermediate in the manufacture of terephthalic acid. Like ethyl benzene and ortho-xylene, this hydrocarbon is recovered from C_8 aromatic reformate fractions. Nearly impossible to isolate by distillative methods, para-xylene is purified by fractional crystallization and co-crystallization (e.g., with carbon tetrachloride). This product is a relatively high-cost feedstock (11.5 cents per lb) and numerous methods have been sought to synthesize terephthalic acid from lower-cost raw materials.

Several processes draw on toluene as raw material. Closest to commercialization is a version of the Henkel process slated for a small commercial unit in Japan. In this process[10] potassium terephthalate is produced by disproportionation of potassium benzoate or by isomerization of potassium phthalate.

Other pilot plant processes drawing on toluene as raw material for terephthalic acid include the method of Bergbau-Forschungs GmbH in which toluene is chloromethylated and the product is oxidized with nitric acid. In a somewhat related development at VEB Hydrierwork Zeitz, crucial parastructure needed for TPA synthesis is obtained by reaction between toluene and carbamyl chloride in the presence of aluminum chloride to form p-toluamide in 90% yield.

In mid-1961, threat of still another toluene-based TPA synthesis was largely responsible for a drop in p-xylene price from 13 to 15 cents per lb to 11.5 cents per lb (contract basis).

Paraffins vs Olefins

The attempt to replace olefins with saturated hydrocarbons as chemical feedstock is impelled by an obvious consideration. According to U. S. Tariff Commission reports, the 1959 average ethane price is reported at 0.8 cents per lb vs 5.0 cents for ethylene. Analogous relationship holds for other olefin-paraffin pairs.

Actually, the fairly low reactivity of saturated hydrocarbons has so far limited their application to few petrochemical applications, notably in chlorination reactions and a few specialized oxidation processes.

Among commercially important chlorination reactions of paraffins is conversion of ethane to ethylene chloride, known to be practiced by one U. S. manufacturer and one British firm. The process competes with the hydrochlorination of ethylene. Its advantage is substantially lower hydrocarbon cost. On the debit side of ethane

chlorination are more extensive formation of higher chlorinated C_2 by-products and formation of co-product HCl. Technical aspects of the ethane chlorination process will be covered by the author in a forthcoming monograph.[11]

Miscellaneous Developments

There is increasing activity in production of ethylene, propylene and acetylene from hydrocarbons above the permanent gaseous stocks making up bulk of feedstocks for such operations. The trend is of particular interest in areas which do not have ready access to natural gas lines; it is aided by the current oversupply in light distillates.

Thus Mobil Chemical will feed naphthas and other natural gasoline stocks to its 380,000,000-lb-per-year ethylene-propylene plant at Beaumont. Monsanto (Texas City) is adding light distillates to its normal LPG feed for ethylene production. For its announced 500,000,000-lb-per-year ethylene plant at Alvin, Tex., Monsanto will use a feed of crude oils and middle distillates.

Germany's Farbwerke Hoechst operates a 100,000,000-lb-per-year acetylene-ethylene plant based on liquid hydrocarbon feed. It employs a two-stage burner in which liquid hydrocarbon is injected into hot gases formed in a pre-pyrolysis chamber by combustion of hydrogen and oxygen.

Several other two-stage converters — SBA Type II, Phillips Petroleum and Chemische Werke Huels — also feature adaptability to liquid hydrocarbons as process feedstock for acetylene production, but none are yet commercial in this service. A recently announced American electric arc process for acetylene production is also claimed to provide satisfactory operation with liquid feedstocks. Still another arc process for pyrolysis of liquid hydrocarbons has been announced by Hungarian workers. Use of liquid charge stocks does not pose any particularly striking technical problem but economic attractiveness at present appears restricted to isolated instances.

Three recent oxidation processes deserve special mention here for the shift they represent in raw materials base. These are oxidation of propylene to acrolein, isobutylene to methacrylates and ethylene to acetaldehyde.

Oxidation of propylene to acrolein, is a fait accompli (two U. S. plants at this writing). The method appears to have obsoleted the conventional method of acrolein synthesis from formaldehyde and acetaldehyde.

Oxidation of isobutene as a route to methacrylates is expected to be commercialized by Escambia Chemical Co. in 1963. The process[15,16] involves liquid-phase oxidation of isobutylene by a mixture of NO_2, N_2O_4 and 100% HNO_3 at about 5 C. Ammonium vanadate has been mentioned as catalyst. The reaction yields α hydroxybutyric acid in a reported 58% yield. This intermediate can be dehydrated to methacrylic acid. An alternative route thus exists for a major monomer (1960 production of methacrylate esters was 126,000,000 lb) obtained today from acetone and hydrogen cyanide.

A somewhat related reaction[17] permits synthesis of lactic acid, a potential intermediate in acrylic acid production. Partly because of fairly low yield (28%), no immediate commercial potential is seen for the propylene oxidation approach. Present commercial synthesis of acrylates (1960 volume = 60,000,000 lb per year) employs several raw materials bases: ketene and formaldehyde (Celanese); acetylene, carbon monoxide and lower alcohols (Rohm & Haas, Dow-Badische), and ethylene oxide plus hydrogen cyanide (Union Carbide).

Process for a novel direct synthesis of acetaldehyde from ethylene is licensed by Germany's Consortium für elektrochemische Industrie, a jointly owned subsidiary of Hoechst and Wacker.

It is already commercial at two German plants (operated by Hoechst and Wacker, respectively), will be the basis of a 100,000,000 lb per year acetaldehyde plant announced by Celanese.

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■

Part 2: Design Charts and Equations

by Dr. A. E. Dukler

Predicting Heat Transfer Coefficients For Film Flow

Design charts based on a newly published theoretical analysis provide the engineer with valuable tools for calculating average coefficients for transfer of heat through thin films.

The analysis was introduced in Part 1 in the August issue, which also described variables involved in determining heat transfer coefficients for such process equipment as condensers, falling film evaporators, gas-liquid reactors, thermosyphon reboilers and steam generators.

Presented here along with the charts are related equations and a discussion of their use.

Local Coefficient Curves

Consider a vertical tube in which a liquid film flows along the wall parallel to the tube axis. Heat transfer takes place either from the gas through the liquid to the wall or vice versa. Direction of this transfer is perpendicular to the tube axis. Generally, the heat transfer coefficient will vary from point to point along the tube. To determine the average coefficient over the entire tube length for use in design, it is necessary first to know the point or local coefficients. These depend on three variables:

The local liquid Reynolds number:

$$Re_{Lx} = \frac{4W_L}{\pi D \mu_L} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The dimensionless liquid property groups:

$$Pr = \frac{C_p \mu_L}{\rho_L} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$\psi = \left(\frac{\mu_L^{\ 2}}{\rho_L^{\ 2} g_L k^3} \right)^{1/3} \quad . \quad . \quad . \quad . \quad . \quad (3)$$

The dimensionless interfacial shear:

$$\beta = \frac{(dP/dL)_{TP} D g_L^{\ 1/3}}{4 \rho_L^{\ 1/3} \mu_L^{\ 2/3}} \quad . \quad . \quad . \quad . \quad (4)$$

Differential equations relating these variables (see Part 1) have been solved numerically using digital computer and numerical techniques. Results appear in Fig. 1 through 6 for Prandtl numbers of 0.1 to 10.0.

The range covered here includes most process fluids except for materials of high thermal conductivity (liquid metals) which have exceedingly low Prandtl numbers and materials of very high viscosity which have high Prandtl numbers.

All these graphs have certain characteristics in common. At the bottom of each graph, the line marked "Nusselt" represents a plot of the equation frequently used for film coefficients.[1]

The graphs show this equation is correct only as the Reynolds number becomes very small and when the interfacial shear is zero ($\beta = 0$). It has long been assumed that the Nusselt equation applied for liquid Reynolds numbers to 2100, where transition to turbulence was thought to take place. It has recently been shown[2] that this transition is gradual, starting at Reynolds numbers below 100. These graphs show that because of this transition, the heat transfer coefficients are higher than would be predicted by Nusselt at low Reynolds numbers.

Note the heat transfer coefficient is relatively insensitive to Reynolds number but varies much more sharply with changes in β and Prandtl number. This means the heat transfer coefficient can be changed much more by altering design or operating variables that change fluid properties or pressure drop than those which change the Reynolds number.

Important design curves appear in Fig. 7. Plotted there are the heat transfer coefficients when pressure drop (or interfacial shear) is negligible. This situation frequently exists for condensation or evaporation on the outside of tubes.

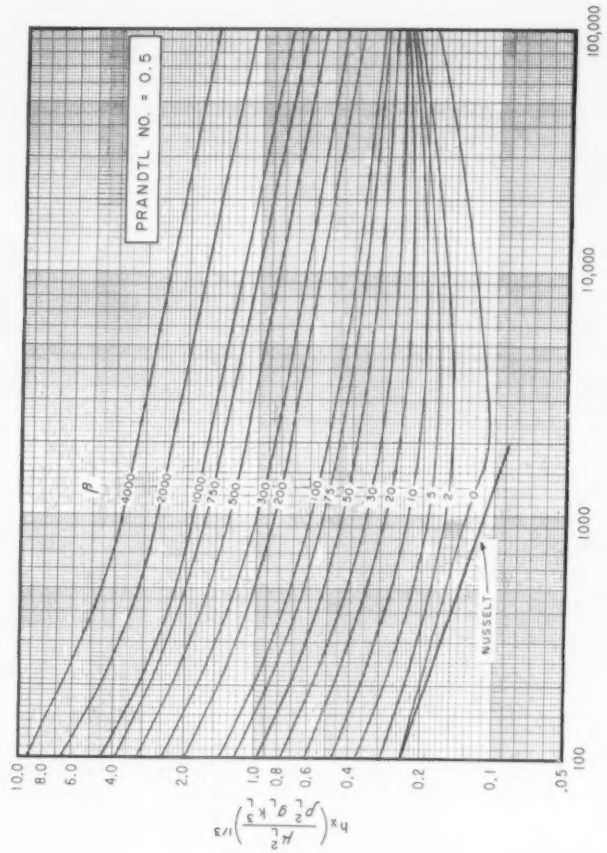
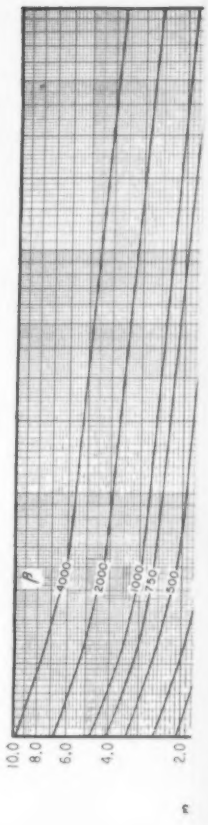


FIG. 2. Local coefficient Prandtl number = 0.5.



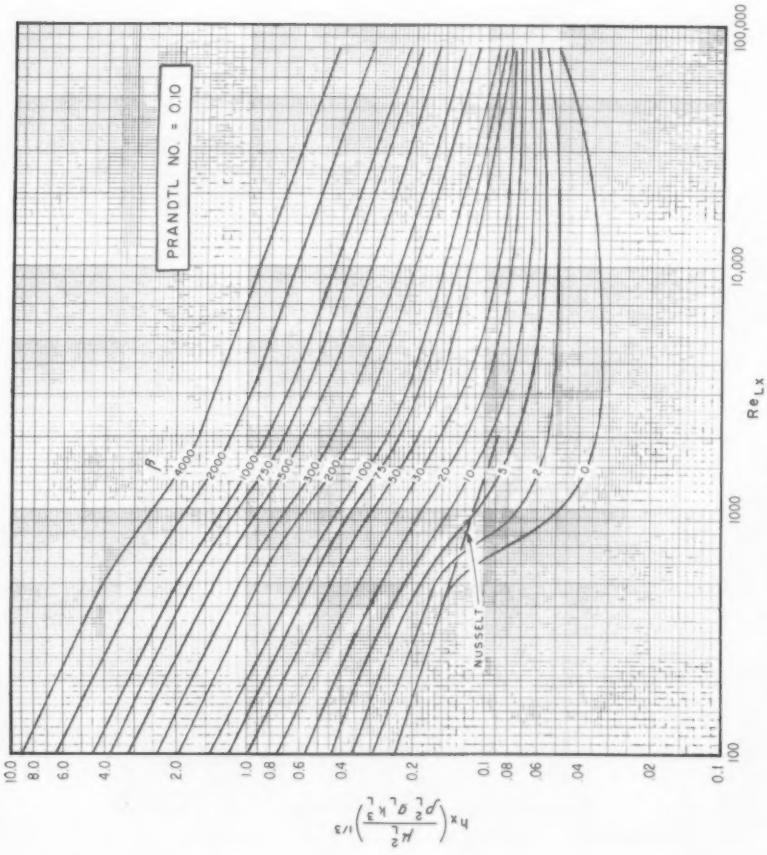
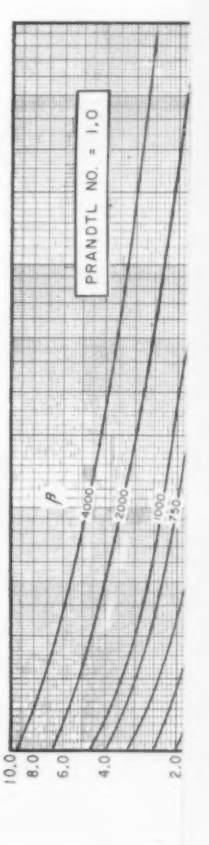


FIG. 1. Local coefficient Prandtl number = 0.10.



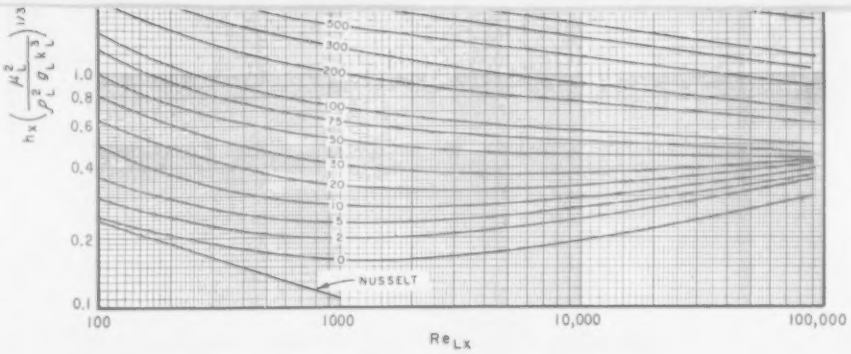


FIG. 3. Local coefficient Prandtl number = 1.0.

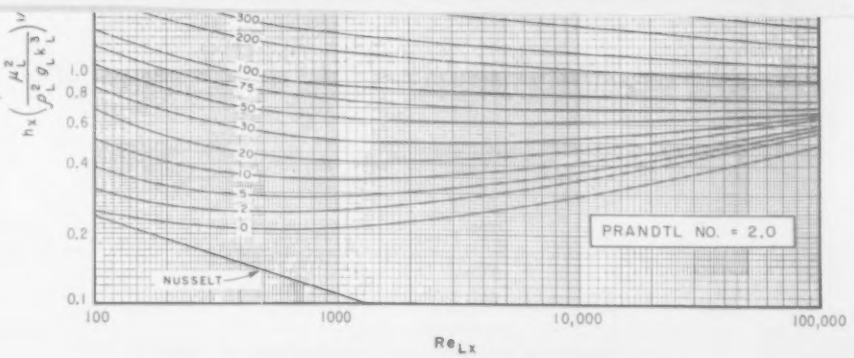


FIG. 4. Local coefficient Prandtl number = 2.0.

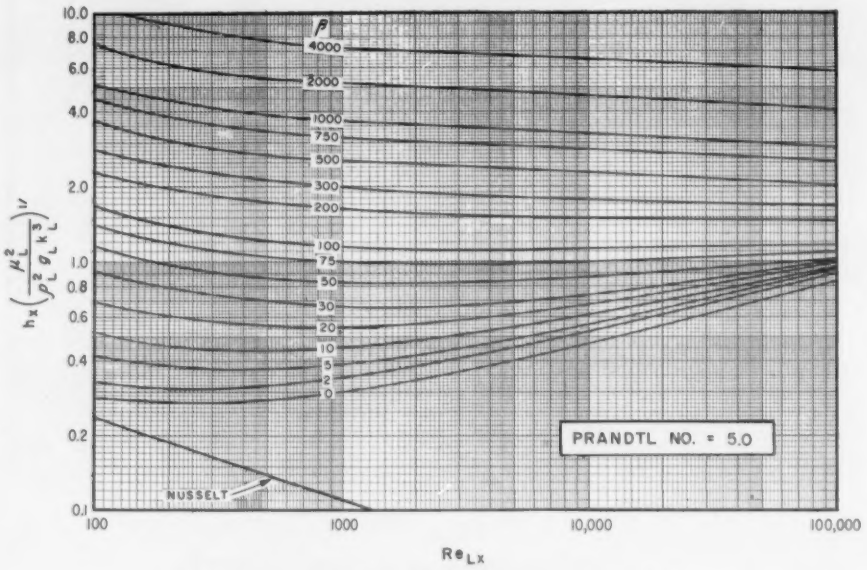


FIG. 5. Local coefficient Prandtl number = 5.0.

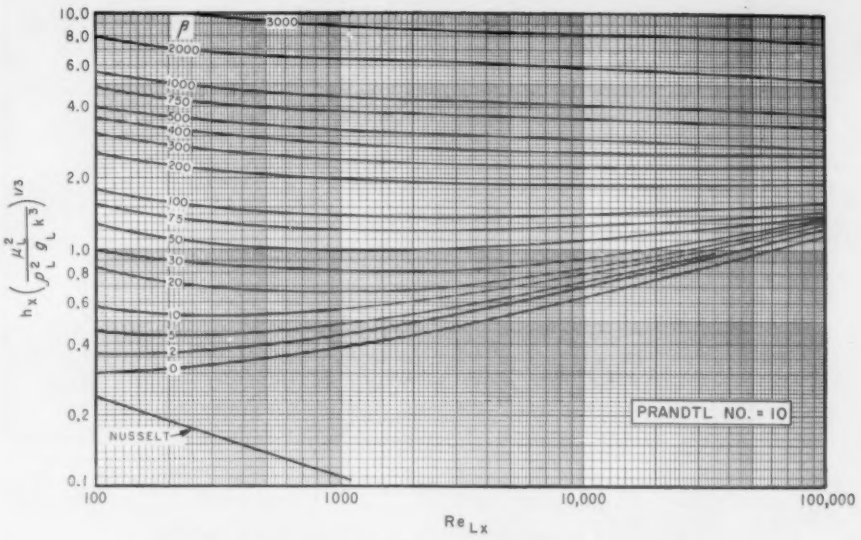


FIG. 6. Local coefficient Prandtl number = 10.0.

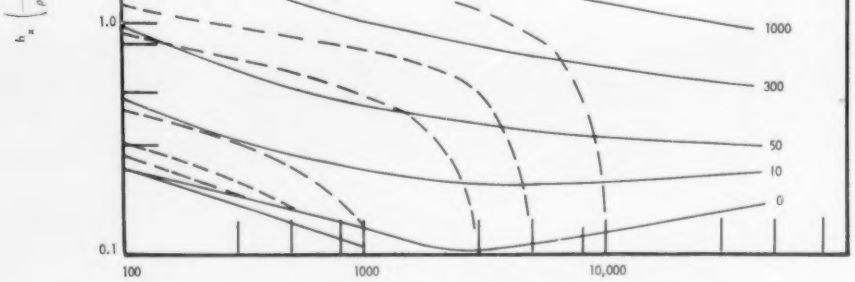


FIG. 9. Plot of path lines for condensation system with interfacial shear.

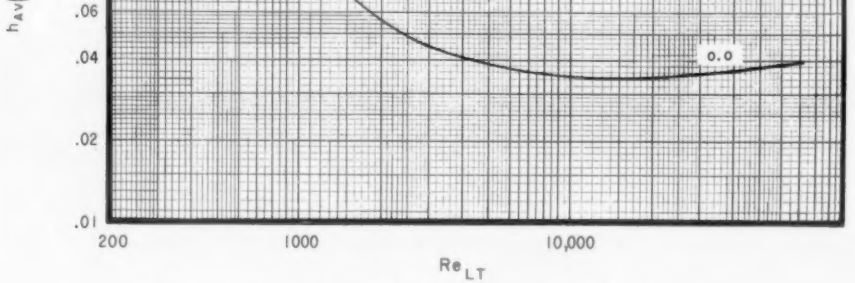


FIG. 10. Average coefficient for total condensation, Prandtl No. = 0.10.

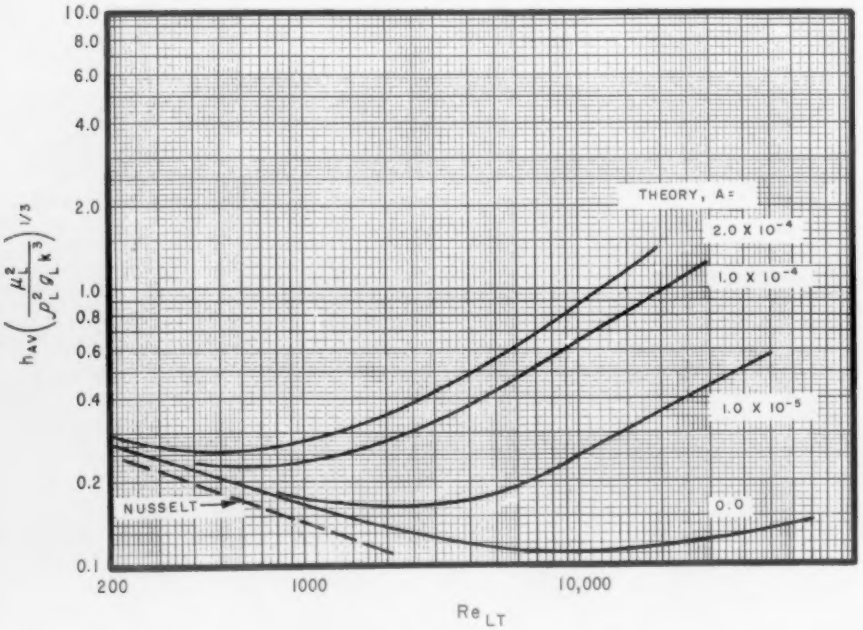


FIG. 11. Average coefficient for total condensation, Prandtl No. = 0.50.

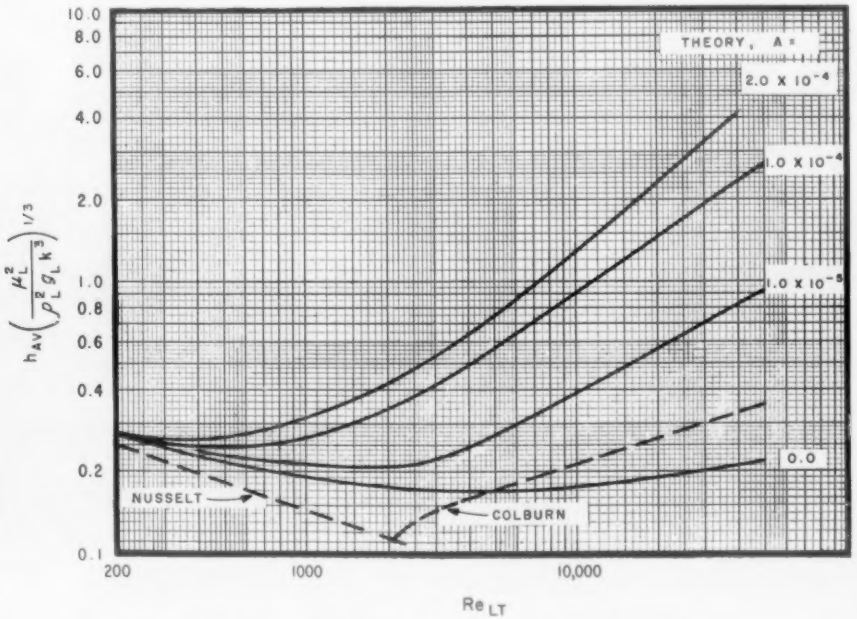


FIG. 12. Average coefficient for total condensation, Prandtl No. = 1.0.

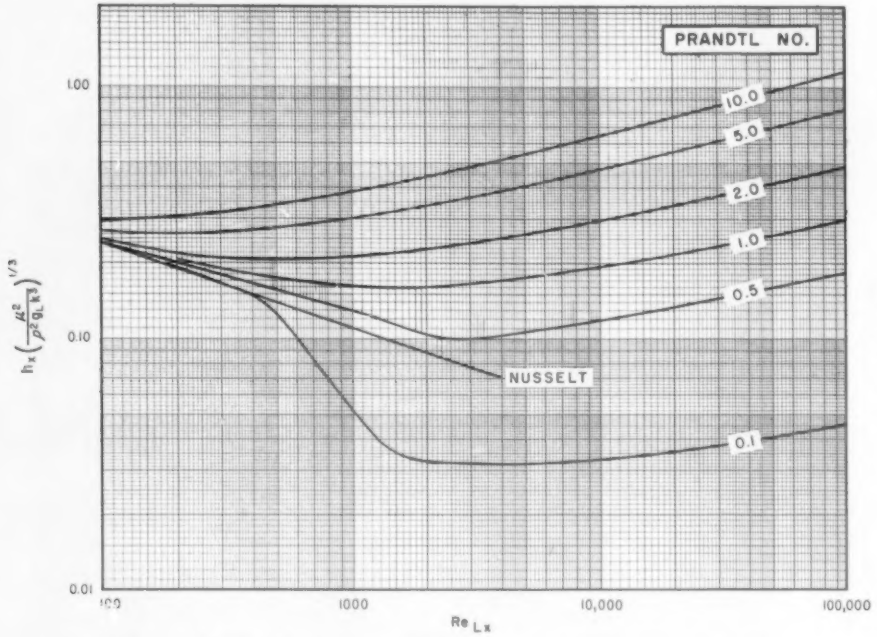


FIG. 7. Effect of Prandtl number on local coefficients, negligible pressure drop, no interfacial shear

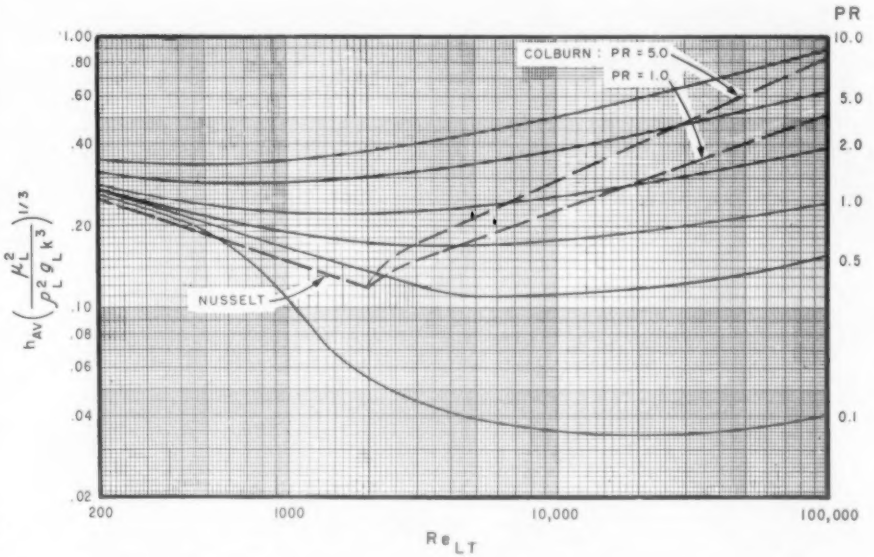
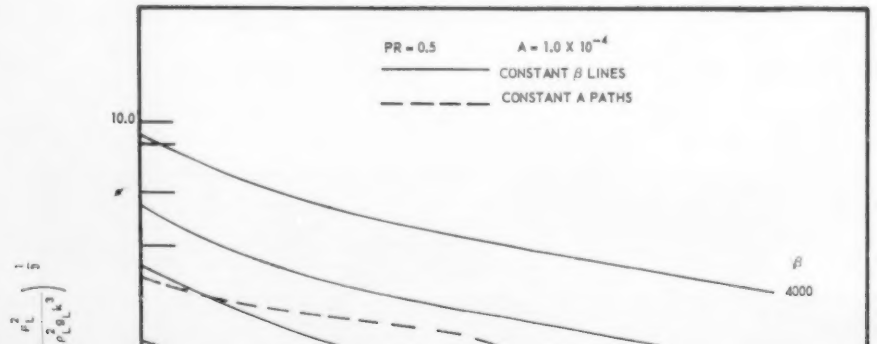
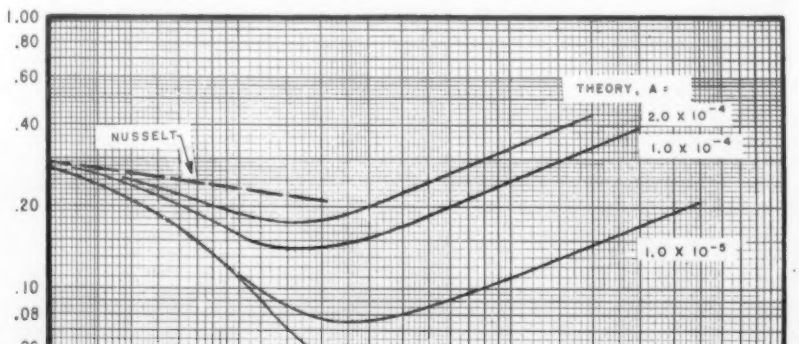


FIG. 8. Effect of Prandtl number on average coefficient, negligible pressure drop.





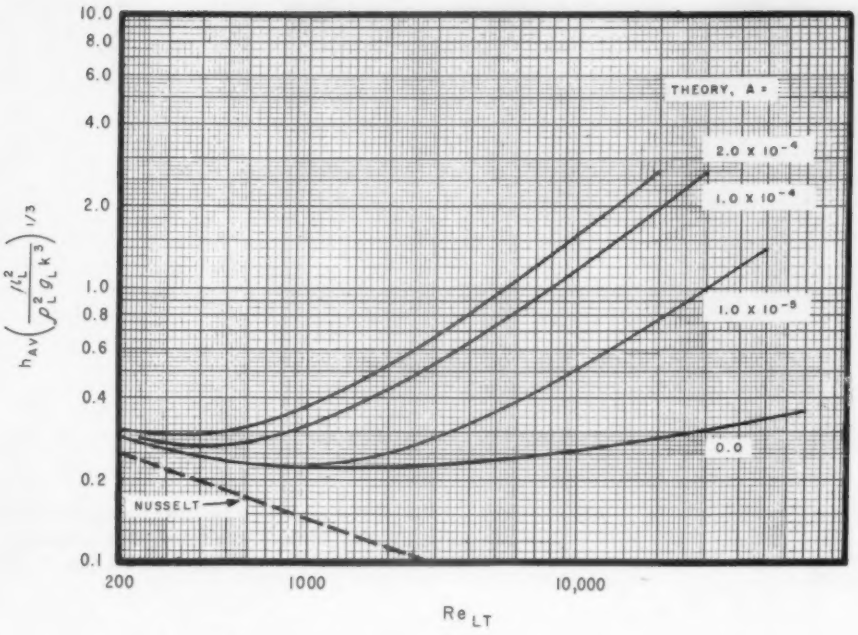


FIG. 13. Average coefficient for total condensation, Prandtl No. = 2.0.

Negligible Mass Change

When the mass flow changes only slightly along the tube axis, the local coefficient curves can be used to obtain the average coefficients in a simple manner. This situation exists, for example, when the amount of liquid condensed out of a gas phase is small (dehumidification) or when a hot oil is used to transfer heat to a gas by a direct contact film method.

If the temperature change is small along the tube, Prandtl number of the liquid can be calculated at the arithmetic average of the inlet and outlet conditions. This determines the particular local coefficient graph to use.

The Reynolds number can be calculated from Eq. 1 and β can be calculated using Eq. 4 once the two-phase pressure drop is determined. When experimental data are available, these should be used. For flow on the outside of tubes in conventional types of exchangers, the pressure drop is usually negligible and $\beta = 0$.

For flow in tubes, where pressure drop may be large, and in the absence of experimental data, the following equations are recommended[2]:

$$\phi_G = 3.3X^{0.22} \quad . \quad . \quad . \quad . \quad . \quad (5)$$

where

$$\phi_G = \left[\frac{(dP/dL)_{TP}}{(dP/dL)_G}\right]^{1/2} \quad . \quad . \quad . \quad . \quad (6)$$

$$X = \left[\frac{(dP/dL)_L}{(dP/dL)_G}\right]^{1/2} \quad . \quad . \quad . \quad . \quad (7)$$

$(dP/dL)_G$ and $(dP/dL)_L$ are calculated assuming each phase flows along in the conduit. For this purpose the usual single-phase pressure drop equations and friction factor relationships are suitable.[3]

In some cases the temperature changes along the tube may be large enough to result in significant differences in the Prandtl number between inlet and outlet. Here the simplest procedure is to divide the tube into a sufficient number of parts so that the Prandtl number does not change much in any one part. The above calculations are repeated for each of these tube sections.

Total Condensation

When condensation takes place, the local coefficient may change significantly along the tube. As condensate is formed the liquid Reynolds number increases. This, combined with a decrease in gas flow, causes a variation in the two-phase pressure drop and in β. When a multicomponent mixture is condensing, the equilibrium temperature also may change along the condensing path, with resultant variation in Prandtl number.

To arrive at a correct average coefficient for the entire length, some information must be developed about the condensing path. Eq. 8 presents relation between average coefficient and local values.

$$h_{av\psi} = \frac{Re_{LT}}{\int_0^{Re_{LT}} \frac{dRe_{Lx}}{h_{x\psi}}} \quad . \quad . \quad . \quad . \quad (8)$$

where Re_{LT} is the Reynolds number at the tube outlet.

This equation assumes constant wall-to-gas temperature difference. Only when the temperature difference varies greatly will significant

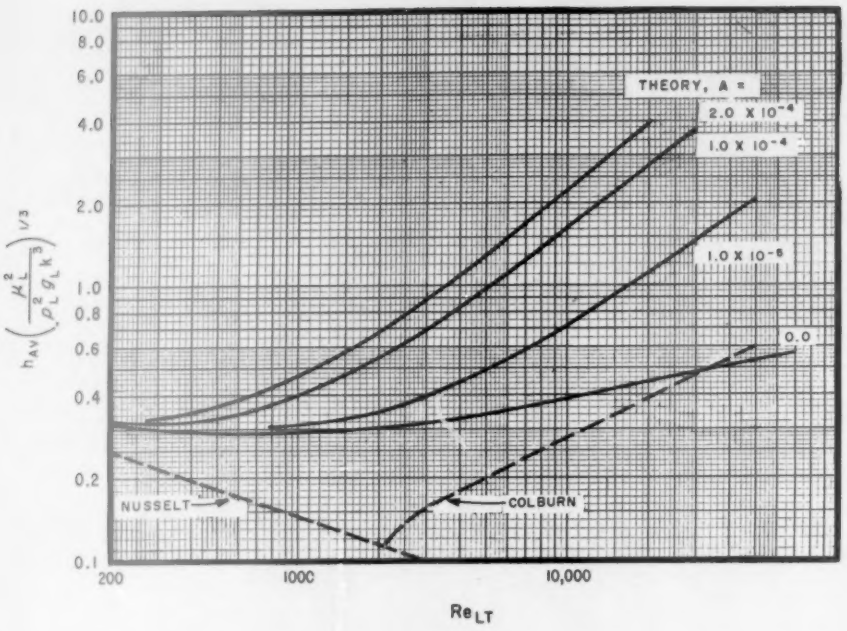


FIG. 14. Average coefficient for total condensation, Prandtl No. = 5.0.

error result. For those cases, the equation can be redeveloped as suggested by Seban.[4]

Negligible Pressure Drop

Under conditions of negligible pressure drop, integration of the local coefficient curves to obtain the denominator of equation[8] can be done graphically along the $\beta = 0$ curves. The result of such integrations appears in Fig. 8. These are design curves for total condensation where pressure drop is negligible.

This provides the coefficient only for that portion of the heat transfer surface over which condensation is taking place. If the vapor enters superheated, coefficient between the entrance and start of condensation must be calculated using conventional single-phase flow equations.

For subcooling, since there is no mass change, it is necessary to use the local coefficient curves at constant Reynolds number and zero interfacial shear (Fig. 7).

Significant Pressure Drop

When the flows are large enough to cause significant pressure drops, the situation becomes much more complicated. Due to condensation the flows change along the tube, the pressure drop changes and so does β. Before the integral of Eq. 8 can be evaluated, the nature of the β variation must be determined. For total condensation, a material balance relates the flow in each phase at any point along the tube to β by

$$\beta = A(Re_{LT} - Re_{Lx})^{0.25} Re_{Lx}^{0.40} \quad . \quad (9)$$

where A is the dimensionless grouping of variables.

$$A = \frac{0.250 \mu_L^{1.172} \mu_G^{0.16}}{g_L^{0.667} D^2 \rho_L^{0.553} \rho_G^{0.78}} \quad . \quad . \quad . \quad (10)$$

Values of A range typically from 1.0×10^{-5} to 2.0×10^{-4}.

A plot of Eq. 9 for a series of values of Re_{LT}, all for one value of A, is shown in Fig. 9. Each of these curves shows the path that the condensation must follow to produce a given terminal Reynolds number.

Plots such as these were prepared over a wide range of terminal Reynolds number for all Prandtl numbers and for all values of A of interest. Graphical integrations were then performed to determine the denominator of Eq. 8 and the average co-efficients calculated. The resulting design curves appear as Fig. 10 through 15 for Prandtl numbers of 0.1 to 10.00.

Partial Condensation

When significant blowthrough of vapor takes place, the equations which led to Fig. 10 through 15 are no longer valid. Then the average coefficient must be determined by graphical integration in each case. The correct procedure is as follows:

1. Calculate the Reynolds number at the tube exit as if the input had been totally condensed, Re'_{LT}.
2. Calculate A.
3. Using Eq. 9 plot the β vs Re_{Lx} curve on the graph with the Prandtl number for the system using $Re_{LT} = Re'_{LT}$.
4. Calculate the Reynolds number of the

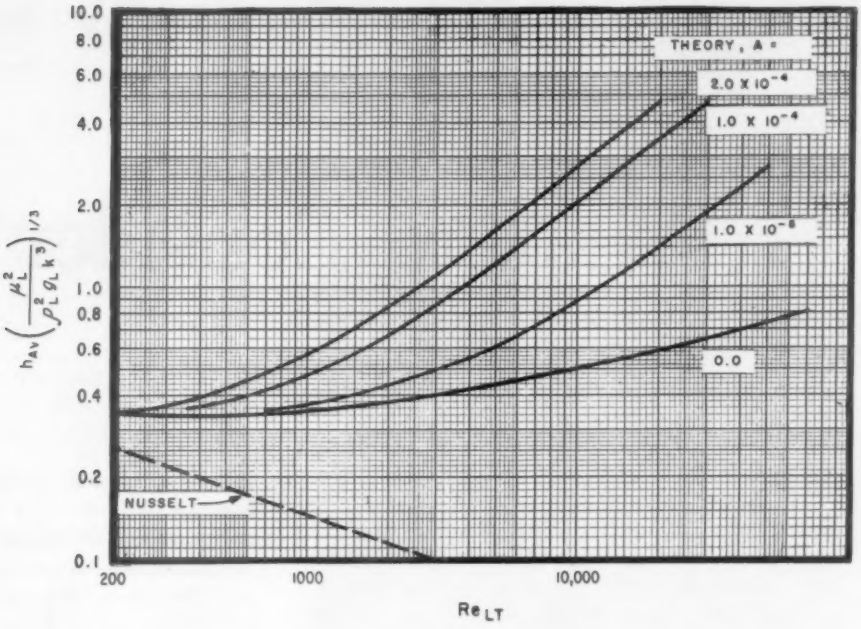


FIG. 15. Average coefficient for total condensation, Prandtl No. = 10.0.

liquid at the tube exit under actual conditions of partial condensation, Re_{LT}.

5. Tabulate values of $(1/h_x)$ (ψ) vs Re_{Lx} along the β curve starting at Re_{LT} and extending to zero. Plot and obtain the area under the curve. This is the integral in denominator of Eq. 8.
6. Calculate the average heat transfer coefficient using Eq. 8.

Application to Other Systems

These local coefficient curves are equally suitable for horizontal condensing or noncondensing systems in annular or crescent flow. This approach also applies to flow across horizontal plates, disks, etc., so long as data are available for pressure drop.

Equations and integrations for special cases other than those discussed here must be developed individually, based on heat and material balances which apply. The methods to be used are similar to the ones shown in this article.

About the Author

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Nomenclature

- A = Dimensionless group, defined by Eq. 10.
- C_{PL} = Specific heat of liquid.
- dP/dL = Pressure gradient due to friction. Subscripts: tp = for two-phase flow; g = for gas phase flowing alone in the same tube; l = for liquid phase flowing alone.
- D = Tube diameter.
- g_L = Acceleration of gravity.
- h_{av} = Average coefficient over the tube length.
- h_x = Local coefficient.
- k_L = Liquid thermal conductivity.
- Pr = Prandtl number, defined by Eq. 2.
- Re_{Lx} = Local Reynolds number, defined by Eq. 1.
- Re_{LT} = Liquid Reynolds number at tube exit.
- Re'_{LT} = Liquid Reynolds number at tube exit when blowthrough is entirely condensed.
- β = Dimensionless interfacial shear, defined by Eq. 4.
- μ = Absolute viscosity. Subscripts: g = gas; l = liquid.
- ρ = Density. Subscripts: g = gas; l = liquid.
- ϕ = Two-phase pressure drop variable, defined by Eq. 5.
- X = Two-phase pressure drop correlating variable, defined by Eq. 6.
- ψ = Property grouping, defined by Eq. 3.

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by James A. Davies and Dr. Kenneth F. Gordon

What to Consider in Your

New recommendations for bubble cap and perforated tray design highlight recent fractionator tray developments valuable to design engineers.

It is becoming general practice to size a bubble tray for vapor and liquid loading close to flooding or priming, rather than to set an arbitrary allowable vapor velocity limitation.

Trays are designed for load point where they operate satisfactorily but would not if vapor or liquid loads were increased slightly, say about 10%.

Previously, entrainment effect was handled by specifying an allowable vapor velocity, based either on the tower overall area or an area corrected for presence of downcomers.

Manufacturers of proprietary trays furnish trays for operation close to their maximum loads, and bubble trays also must be designed close to their maximum load point to compete.

Flooding occurs where there is insufficient downcomer capacity. The downcomer becomes full of liquid, which results in the column flooding and carrying overhead large amounts of liquid. Entrainment and froth height above the tray are low even up to flood point.

Priming takes place where froth height and entrainment are high. This either overloads the downcomer with liquid or, more commonly, increases tray pressure drop sufficiently to prime the column. It results in carrying overhead sizable amounts of liquid as in flooding. However, liquid levels in the downcomers are usually low just prior to the prime point. This is opposite to the condition prevailing close to the flood point.

It is essential to have a sound basis for determining both column and downcomer sizes. They are interrelated inasmuch as the column has to be large enough to allow for a suitable downcomer. Sizes can be figured by knowing the entrainment and the downcomer capacity.

Effect of Entrainment

Entrainment affects overall tray efficiency in accordance with the equation[4]:

$$E_a = \frac{E_{MV}}{1 + e' \frac{E_{MV}}{L_M}} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Where e'/L_M represents fraction of downflowing liquid entrained. The table shows effect of this ratio on the overall tray efficiency:

E_{MV}	e'/L_M	E	% Correction factor
0.50	0.05	0.488	98
0.50	0.10	0.475	95
0.50	0.20	0.455	91
0.50	0.50	0.40	80
1.00	0.05	0.95	95
1.00	0.10	0.91	91
1.00	0.20	0.835	83.5
1.00	0.50	0.67	67
1.50	0.05	1.40	93
1.50	0.10	1.30	87
1.50	0.20	1.15	77
1.50	0.50	0.86	57

Note the lower the Murphree tray efficiency the greater the amount of entrainment necessary to cause a given percent correction in the overall tray efficiency.

Some designers[3] recommend designing trays to give a 10% reduction in overall tray efficiency due to entrainment. At a Murphree efficiency of 50% this means a 20% greater liquid load to be handled by the tray and downcomer. In designing a tray, amount of entrained liquid should be included in the amount of downflowing liquid.

Since the number of actual trays required is the important thing and not the overall efficiency per se, it is suggested the tray be designed for a given e'/L_M ratio:

$$\text{Additional actual trays} = (\text{Theoretical trays})\ e'/L_M \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Therefore, for a given e'/L_M, the same additional trays will result regardless of the efficiency. It is recommended the maximum allowable entrainment be determined to give $e'/L_M = 0.10$.

The method to use for calculating entrainment was recently published by AIChE[1] and developed by one of the authors. It is based on the correlation of Hunt et al,[5] shown on Fig. 1. Entrainment, e, shown is given in

Part 1. Bubble Cap Trays

Tray Design

lb/lb of dry vapor. This must be converted to moles/hr for use in Eq. 1. This may be conveniently done by the equation

$$e'/L_M = 449\ e^{0} \frac{V\rho_g}{Q\rho_l} \quad . \quad . \quad . \quad . \quad (3)$$

Vapor velocity, u_G, is based on the bubbling area, tower area between outlet weir and inlet downcomer or weir. This basis was used for simplicity since u_G is calculated to determine tray efficiency. Also, great bulk of the vapor passes through the bubbling area and only a little through the column section above the downcomer.

S′ is distance between top of froth on the tray and deck of tray above.

$$S' = t - 2.53F^2 - 1.89h_{Wo} + 1.6 \quad . \quad . \quad . \quad (4)$$

Terms to right of t denote visual froth height on the tray. This is found via the equation[1]

$$Z_f = 2.53F^2 + 1.89h_{Wo} - 1.6 \quad . \quad . \quad . \quad . \quad . \quad (5)$$

It is recommended[5] the downcomer be designed for either a 5-sec minimum clear liquid residence time in the downcomer between trays or a maximum clear liquid level buildup of 50%. Fig. 2 describes these terms. However, it is known proprietary trays are designed for residence times of less than 4 sec for non-foamy liquids.

Workability of less than 5-sec downcomer residence time for bubble trays handling non-foamy liquids is confirmed by experience of the authors. If short residence times are present, less vapor can disengage in the downcomer and downcomer will flood at a lower clear liquid level than when a long residence time is available. It is recommended that downcomers be designed to fall within the designated area shown on Fig. 3. For foamy liquids, residence times must be increased, and for extremely foamy liquids, times should be double those used for non-foamy liquids.

Cross Vapor Flow

When a large cross flow tray has an appreciable clear liquid gradient, Δ, a horizontal flow

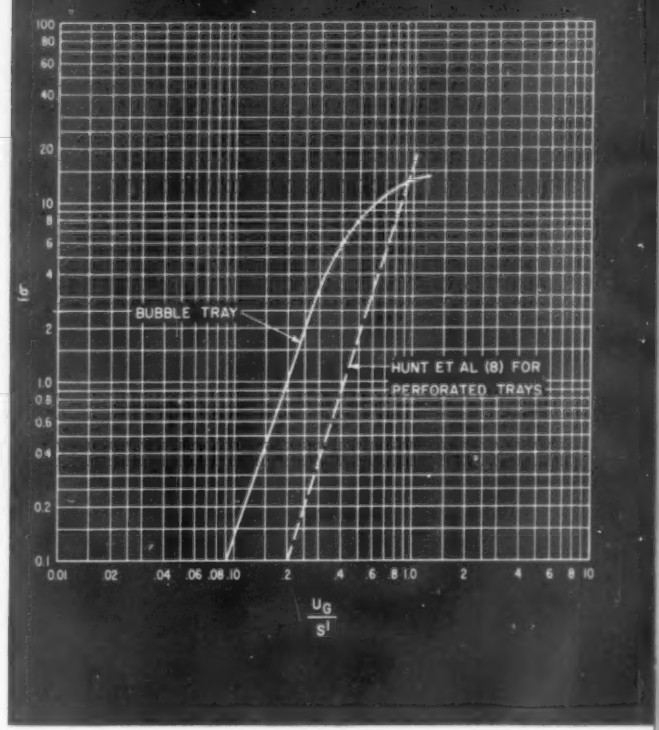
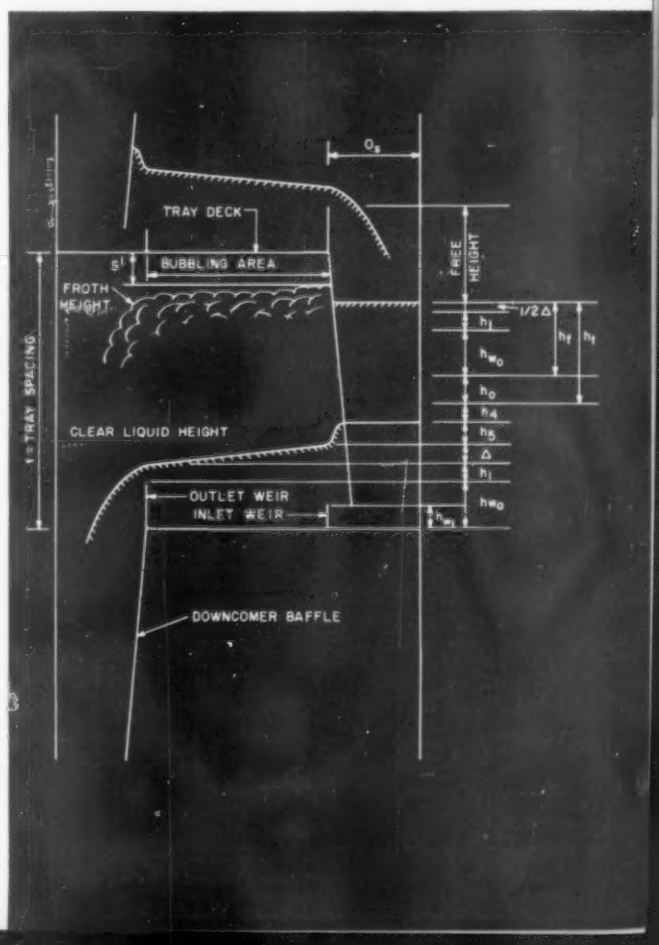


FIG. 1. Entrainment correlation.

FIG. 2. Tray nomenclature.



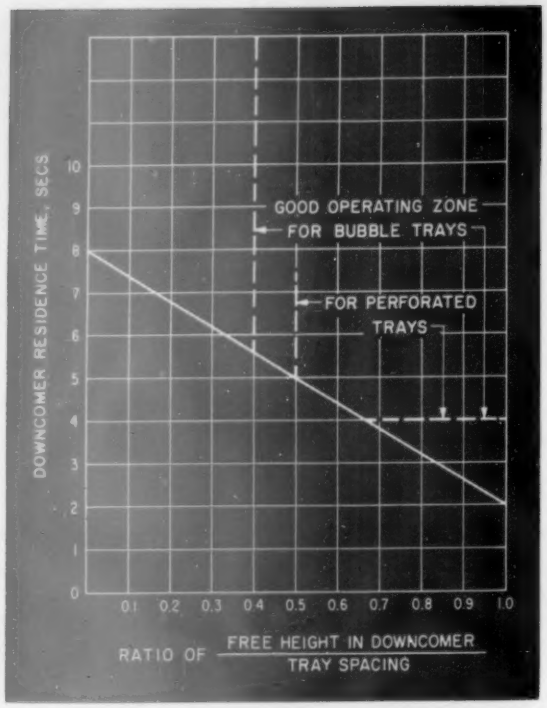


FIG. 3. Downcomer capacity.

of vapor across the tray countercurrent to the liquid flow will be induced. If the Δ is large or if there are deep cross beams supporting the tray above, there will be a smaller area for this vapor flow and large velocities will result. Since the vapor flow is countercurrent to liquid flow, liquid gradient will be larger. Amount of vapor flowing countercurrent to liquid flow in center of a tray section can be obtained by the equation

$$V_{center} = \frac{cr\Delta}{4m'} \quad . \quad . \quad . \quad . \quad . \quad (6)$$

This equation is based on observation that when h_s, as the ordinate is plotted against the vapor rate through one cap, a straight line results for normal operating rates. It is also assumed liquid gradient is a straightline across the tray section and number of rows is large.

It is recommended that maximum F-factor for horizontal flow of vapor at the center be 2.0.

Vapor Distribution Ratio

The vapor distribution ratio is defined as Δ/h_s and gives a measure of the vapor distribution on the tray. It is recommended[5] this ratio be less than 0.4 normally and never greater than 0.6. It is further recommended that except for small diameter columns, 3 to 4 ft, the 0.6 ratio never should be used. For large diameter columns, over 8 ft, ratio never should exceed 0.4. This ratio approaches 2 when the inlet row of caps ceases to bubble.

This ratio is easily calculated but does not give a true measure of vapor distribution. Making same assumptions as in deriving Eq. 6 the following equation giving true vapor distribution can be derived:

$$V_o/V_i = \frac{m'V + 0.5\,c(r-1)\Delta}{m'V - 0.5\,c(r-1)\Delta} \quad . \quad . \quad (7)$$

When Δ/h_s is 0.4, vapor ratio for the normal case will be 1.5.

Shower Decks

Shower decks are being used in increasing numbers for simple separations such as side strippers in petroleum refining. Their main advantage is cheapness and large capacity. Their efficiency is low, probably at least half that of bubble and perforated trays.

There are two zones of action for vapor flowing up a column with shower decks — between decks, where vapor contacts liquid droplets and in the segments at ends of decks, where liquid droplets drop out of vapor.

An allowable vapor velocity equation similar to Souders-Brown equation but neglecting the vapor density when compared with the liquid density is

$$G = K\sqrt{\frac{MP_s}{ZT}} \quad . \quad . \quad . \quad . \quad . \quad (8)$$

For the classical allowable mass vapor velocity for bubble and perforated trays, K in this equation would be a little smaller than 2000. For shower decks these values of K have been used:

Between decks	K = 10,000
At segments	K = 5,000

Decks are spaced to result in a K close to that given above. Holes in deck are located near dam at segmental side of deck and away from segmental area of tray below. Hence, liquid dripping through holes will drop to tray below and not through segment area. Dams are usually 4 to 6 in. high. Clear liquid depth on decks is maintained less than half of dam height by providing sufficient holes. Using a common orifice equation with an orifice constant of 0.6, this equation can be developed:

$$n = \frac{0.29\ Q}{d^2\sqrt{h_f}} \quad . \quad . \quad . \quad . \quad . \quad (9)$$

Holes measuring 3/4 in. have frequently been used.

(Nomenclature and references which follow also apply to Part 2 of this series, to appear in the December issue.)

Nomenclature

A_B = bubbling area, sq ft, taken between downcomer baffle or inlet weir and overflow weir.
A'_B = deck area containing perforations, sq ft.
A_d = downcomer restriction area, sq ft.
A_H = total hole area, sq ft.
b = average liquid flow width, ft.
C'_d = orifice constant.
c = average number of caps per row.
D = tray plate thickness, inches.
d = hole diameter, inches.
E_a = overall tray efficiency after correction for entrainment.
E_{MV} = Murphree tray efficiency.
e = amount of entrainment per amount of liquid.
e' = entrainment, lb moles/(hr) (sq ft).
e_o = entrainment, lb/lb of vapor.
F = F - factor, defined as $u_G\sqrt{\rho g}$
f = fraction of hole area to bubbling area.
G = vapor mass velocity, lb/(hr) (sq ft).
H = fraction of free height in downcomer.
h_c = actual flowing submergence, inches of hot clear liquid.
h_D = dry tray pressure drop, inches of hot clear liquid.
h'_D = dry tray pressure drop, inches of water.
h_f = calculated flowing submergence, inches of hot clear liquid.
h_n = height of notches in weir, inches.
h_t = total tray pressure drop, inches of hot clear liquid.
h_{w_i} = inlet weir height, inches.
h_{w_o} = outlet weir height, inches, taken to bottom of notches.
h_1 = liquid crest on overflow weir, inches (measure from bottom of notches when present).
h_2 = static submergence, inches, measured, from top of tray slots to bottom of weir notches.
h_3 = pressure drop through caps and risers for wet tray (assumes vapor is evenly distributed among the caps and risers), inches of hot clear liquid.
h_4 = pressure drop through overflow constriction area, inches of hot clear liquid.
h_5 = additional liquid head caused by inlet weir, inches.
K = constant in equation for allowable mass vapor velocity in column.
L = liquid rate on tray, gpm per foot of average flow width.
L_M = liquid flow rate for bubbling area, lb moles/(hr) (sq ft).
l_w = weir length, inches, taken straight across top of weir whether notched or not.
M = molecular weight of vapor.
m' = slope of curve obtained by plotting h_3 as ordinate vs vapor rate, V, through one cap and riser.
N = downcomer volume, cu ft.
n = number of holes per tray.
O_S = maximum horizontal distance liquid travels in flowing over outlet weir, inches.
P = total pressure, lb/sq in.
ΔP = total vapor pressure drop per tray, lb/sq in.
Q = clear liquid rate, gpm, includes entrained liquid.
Q' = clear liquid rate, gpm, no entrainment.
r = number of rows of caps per tray, tray section.
S = hole spacing, inches.
S' = distance between the top of froth on a tray and the tray above.
s = specific gravity of hot clear liquid.
T = vapor temperature, deg R.
t = tray spacing, inches.
t' = tray spacing, feet.
u_G = superficial vapor velocity based on bubbling area (between downcomer baffle and overflow weir), ft/sec.
u_{max} = superficial vapor velocity based on total column area, ft/sec.
V = total vapor rate, cu ft/sec.
V_i = vapor rate through inlet row of caps, cu ft/sec.
V_o = vapor rate through outlet row of caps, cu ft/sec.
V_{center} = horizontal vapor rate at center of tray section countercurrent to liquid flow, cu ft/sec.
Z_f = visual froth height, inches.
Z_l = distance between the inlet and outlet weirs, feet.
z = compressibility factor.
Δ = liquid gradient, inches.
θ = downcomer residence time, seconds.
μ = viscosity of the clear liquid, centipoises.
ρ_g = density of vapor, lb/cu ft.
ρ_l = density of liquid, lb/cu ft.
σ = surface tension of liquid, dynes/cm.

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■

by David E. Jackson and Jack C. Scott

What You Should Know About Electrostatic Coalescing

Electrostatic coalescing is recognized as an invaluable tool throughout the refining industry.

Present daily capacity of electrostatic desalters is over 8,000,000 bpd, and intermediate or finished product treating capacity over 4,000,000 bpd.

The process is generally employed to remove some undesirable substance either by chemical reaction or extraction where a highly conductive liquid has been emulsified with one of relatively low conductivity.

Theoretical Aspects

Separation rate of an emulsion, with resulting precipitation of the heavier discontinuous phase, depends on velocity at which droplets of dispersed liquid will fall under influence of gravity. This is expressed by Stokes' law:

$$v = \frac{2\,gr^2}{9n}\,(d_1 - d_2)$$

where v = rate of fall of a spherical drop under influence of gravity.
r = radius of drop.
n = viscosity of continuous phase.
d_1 = density of discontinuous phase.
d_2 = density of continuous phase.
g = gravitational constant.

Faster precipitation may be achieved by increasing droplet size since rate of fall is directly proportional to the square of radius of the drop. While viscosity and density differential also affect settling rate, they will remain constant for a given system under constant conditions.

Using an electrostatic field neatly expedites coalescence of small droplets to form larger drops. When the emulsion enters the electrostatic field, a small fraction of the conductive particles will possess a static charge, but the majority will be uncharged.

When an uncharged conducting body is brought into an electric field, the field will be changed. The conductor cannot support an electric potential gradient in a static condition and will place all space within its boundaries at an equipotential. Because space occupied by the conducting body must become equipotential, remainder of the field space will possess new values of electric field conditions. The free electrons or ions of the inserted body will be forced toward those surfaces which lie toward the regions of higher potential. Net value of the charge on the inserted body must be zero because the free electrons of the conductor can only be moved about by the action of the field and not removed or added to it.

What Causes Coalescence

When a nonconductive liquid containing a dispersed conductive liquid is subjected to an electrostatic field, the conductive particles or droplets are caused to combine by one of three physical phenomena:

1. The droplets become polarized and tend to align themselves with the lines of electric force. In so doing, the positive and negative poles are brought adjacent to each other and electrical attraction brings the droplets together and causes them to coalesce.

2. Particles are attracted to and collect on the electrodes forming larger and larger drops until eventually they fall by gravity.

3. When each droplet is polarized it exerts its own changing influence on the imposed field. Since there are a large number of droplets and the position of each droplet in the field is constantly changing, the electric field condition at every point in the field will be constantly changing. This influence causes the droplets to move about rapidly in random directions, which greatly increases the chances of collision with

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In addition to offering low octane improvement costs, lead antiknock compounds provide an important road-performance bonus—a bonus that can come only from antiknocks and which increases with higher lead concentrations. Further, gasoline sensitivity can be decreased through the use of antiknocks.

These factors all add up to the need for a new look at octane-improvement costs and a reappraisal of the balance between antiknocks and processing.

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another droplet. When droplets collide with the proper velocity, coalescence occurs.

It is difficult to determine experimentally the relative effects of these three phenomena, but hundreds of laboratory tests indicate random motion of particles in the field is the major contributor to droplet size increase when a nonconductive liquid containing a dispersed conductor is subjected to a d-c field. Microscope studies of coalescence of water in semiconductive crude oil subjected to an a-c field indicate polarization and subsequent alignment of droplets along the lines of electric force, plus harmonic vibrations due to frequent alternation, are main contributors to coalescence. Probably coalescence in much larger systems of semiconductors is effected to a greater extent by other phenomena. Visual observations of electrical coalescence in larger volumes of crude oil are almost impossible due to its opaqueness.

Electrostatic coalescing is used extensively for treating both crude oil and distillate products. Crude is treated for removal of salt and solid sediment by washing with water. Distillate products are treated with numerous chemical agents for removing undesirable compounds.

Most widely used chemicals in this field are sulfuric acid and caustic soda, although many others have been applied including sodium hypochlorite, sodium sulfide, potassium hydroxide and water. Water is used in some applications as a wetting agent for solid particles such as iron sulfide to render these particles susceptible to effects of the electrostatic field. In some applications no agent is added; the oil is subjected to the electrostatic field to coalesce inherent water or haze.

There are undoubtedly many other applications in HPI. The process is generally applicable to any system involving two immiscible substances in which the continuous phase is nonconductive or semiconductive and the discontinuous phase is conductive, or may be wetted by a conductive liquid.

Description of Equipment

Simply stated, an electrostatic coalescing unit consists of a vessel containing two or more electrodes, one grounded to the vessel and the other suspended by insulators, plus an electrical system through which an electric potential is applied to the suspended electrode. While numerous arrangements and configurations of electrodes have been employed, the most widely accepted have been vertical parallel plates and horizontal parallel grids. Arrangement and spacing of electrodes depend on characteristics of the substances to be processed and process conditions. Intensity of the electrostatic field is controlled by spacing of electrodes and applied voltage. Optimum field intensities vary with applications, but generally fall within the range of 2000 to 4000 v per in.

Electrical apparatus supplying potential to the electrodes consists of a system of step-up transformers (either single or three-phase) in which the primary side is connected to a low voltage power source (generally 220, 440, or 550 v) and secondary windings are so designed that induced voltage will be of desired magnitude. The applied potential is controlled by varying the primary voltage.

If a d-c field is desired, a rectification system must be installed on the high voltage side of the transformer system. Rectification may be accomplished by use of either vacuum tubes or the conductor — semi-conductor diode-type rectifier. The latter type are more desirable because of their virtually unlimited service life. In applications employing d-c fields, current flow, and hence power consumption, is negligible.

A-c fields are generally employed where the continuous phase liquid is a semiconductor, as in desalting of crude oil. Most crudes are treated at temperatures of from 200 to 250 F to reduce viscosity, and at these temperatures resistivities usually will be in the order of 0.5×10^8 to 12×10^8 ohm-cm. Power consumption in these applications is in the order of 0.4 to 0.8 kw per thousand barrels of oil processed.

A-c fields have two important technical advantages over d-c fields in treating semi-conductive oils. First is avoidance of cataphoresis — the streaming bodily of the liquid from one electrode to the other along the more intense force lines — which tends to disrupt the chains of droplets and prevent their formation and coalescence. Second is elimination of danger of electrolytic corrosion of the apparatus.

Where the continuous phase is a relatively clean nonconductive oil, d-c fields are definitely advantageous for more complete coalescence of extremely small particles. In addition to components discussed above, coalescing units are equipped with inlet distributors, various baffle arrangements to control and direct flow pattern of the material through the vessel and instruments to control interface level.

Process design variables encountered in designing coalescing units for the petroleum industry would in all probability apply to any application.

Feed rate is major controlling factor in sizing vessels for coalescing units. Vessels are generally sized for a certain volume flow per unit time per square foot of cross sectional area

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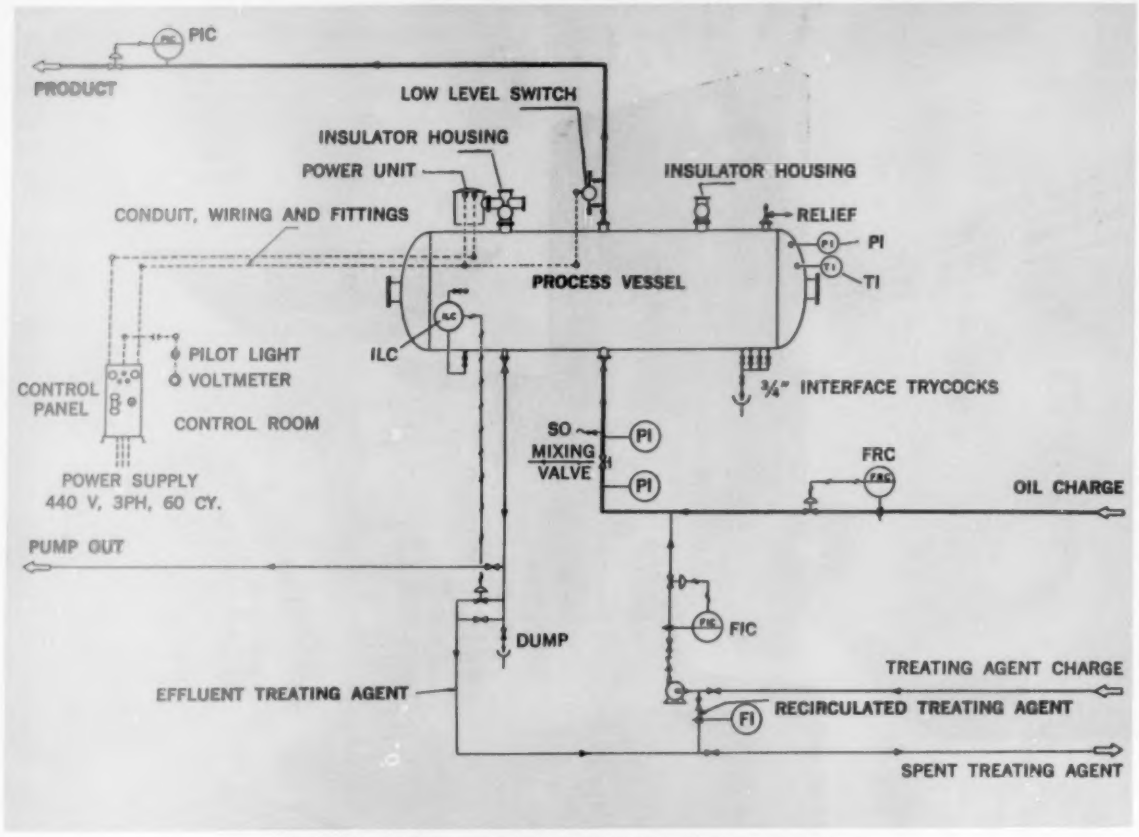


Typical flow diagram of electrostatic coalescer, one stage.

at the center line. Design rate of flow varies considerably for different applications.

In general the heavier, more viscous oils require larger vessels for a given throughput. The viscosity factor in Stokes' law readily explains this necessity of allowing more settling time. In addition, coalescence is affected by viscosity since the random motion of particles in the field is impeded by resistance of the more viscous oils.

Density differential, as indicated in Stokes' law is the driving force in precipitation and becomes critical when density of the oil approaches that of the discontinuous medium.

The combination of these factors makes it apparent that in sizing vessels allowance must be made for both longer residence time in vessel as well as longer time in electrostatic field as the density differential decreases and viscosity increases.

There is no decided disadvantage for oversizing from the standpoint of precipitation, but there is a debit for additional cost. Undersizing, on the other hand, has obvious detrimental effects. Rapid upward flow of the oil not only resists the downward fall of coalesced drops but causes turbulence and eddy currents which disturb the quiescence necessary for efficient coalescing.

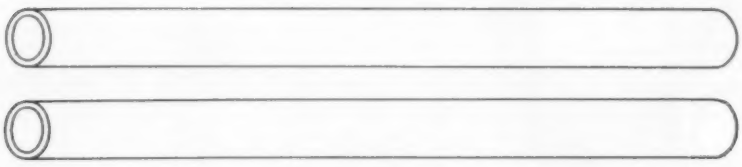
Residence time may vary from five minutes to two hours. Extreme cases range from precipitating heavy sulfuric acid from light nonviscous alkylate, which requires only about five minutes residence time, to precipitation of water from a viscous 12 deg API crude oil, which required some two hours. Most applications will require between 15 minutes and one hour residence time.

Time in the electrostatic field is controlled by electrode spacings and configurations. An electrostatic field exists throughout the body of the oil dielectric within the vessel although, in general, reference is made to the more intense fields in vicinity of the electrodes.

Mixing Energy

Energy input with which the conductive agent is dispersed into the continuous phase dielectric controls the initial size of the dispersed particles. Since this is the starting point from which coalescence proceeds, it is appar-

What's so different about stainless tubing?



What's so different about stainless tubing? Take two stainless tubes made by different manufacturers to the same specification. Put them in a heat exchanger. In service, they may react differently.

One tube successfully resists corrosion, the other doesn't. One holds up under pressure at operating temperature, the other fails. Why?

Basically, the difference in stainless tubing starts with who makes it.

One manufacturer maintains quality controls from melting of steel to finished tube. Another may not. One tube maker will carefully match stainless grades and properties to be sure the tube is *Job-Matched* to the user's specific requirements. Another won't. The differences go on and on.

The surest way to know how the differences in stainless tubing will benefit you is to know the manufacturer and what he can do. Then, specify his product by name when you order direct or through your Steel Service Center. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

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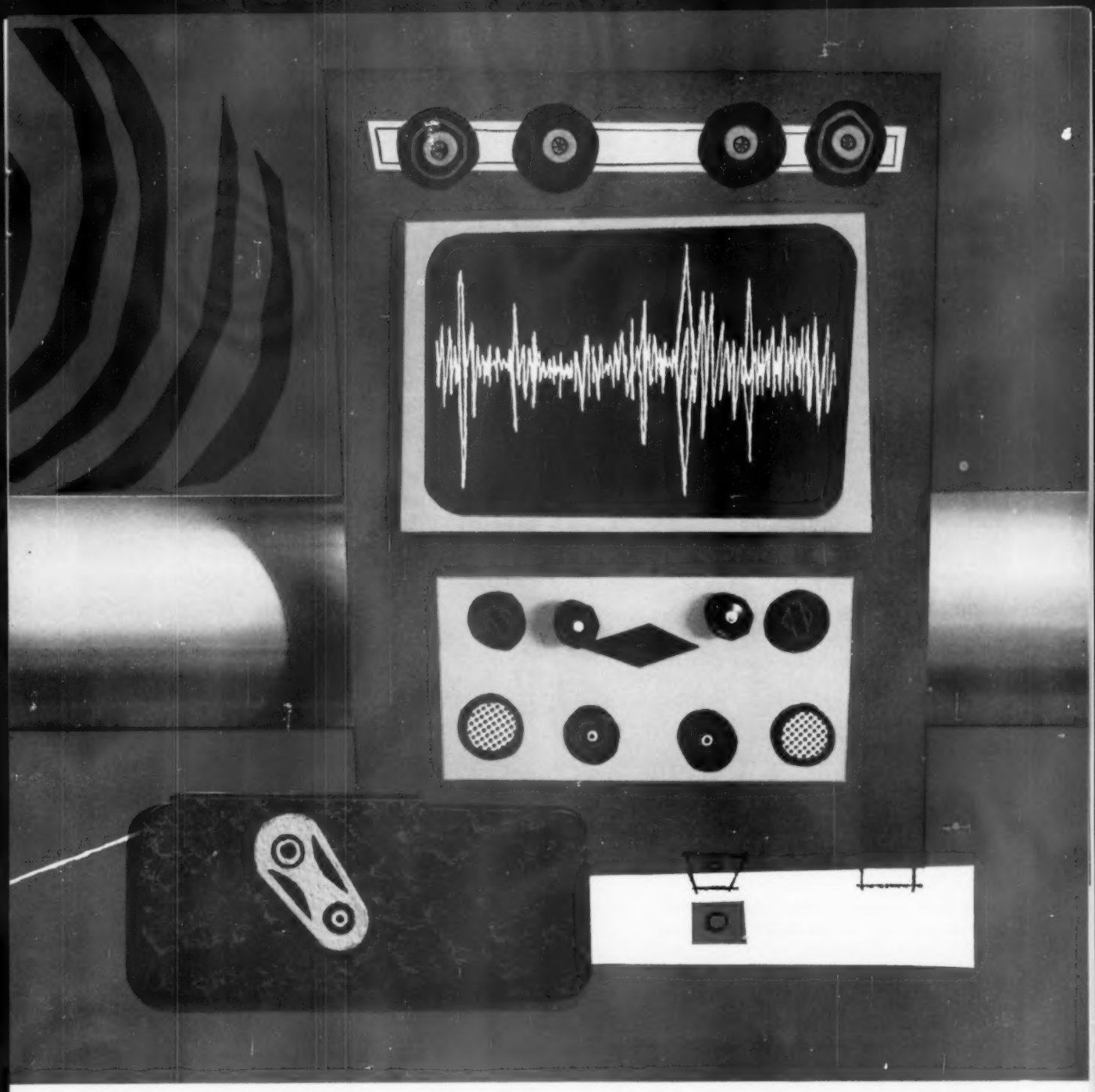
If a bad weld is reflected, the electrical current dances wildly on the screen and triggers an alarm system. The crooked pattern is pen-recorded on a graph, a bullfrog-voiced horn croaks loudly, and the tubing is squirted with black paint to mark the defect.

In case the ultrasonic unit breaks down, a red-faced dome



light automatically flashes, revolves and winks at the weld inspector. This blushing signal tells him that the unit needs to be repaired. It's added insurance that every length of tubing is completely tested before it leaves the plant.

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ent that extremely small particles require more time to coalesce to a given dimension where precipitation occurs.

On the other hand, there must be sufficient mixing energy to effect the desired chemical reaction or contact between the treating agent and the material to be extracted. As a given volume of treating agent is divided into an increasing number of smaller droplets, the interfacial surface area where reactions occur is increased in inverse proportion to diameter of the small droplets.

A distinct advantage for electrostatic coalescers is the treating agent may be thoroughly dispersed initially, thus effecting greater reaction efficiency. The electrostatic field then coalesces these small particles and efficiently separates the two phases.

Mixing is accomplished by either turbine blade mixers or by passing the two phases through a variable line restriction, usually a standard globe valve. Mixing energy in the turbine blade mixer is controlled by varying the speed of rotation, and in the mixing valve by varying the pressure drop across the valve.

The optimum mixing energy is that which effects the desired reactions while not causing severe emulsification of the two phases. As measured by pressure drop across a mixing valve, the mixing may vary from less than 1 psi in the case of neutralizing naphthenic acids in gas oils to up to 35 psi in desalting some crude oils.

Temperature

In most cases distillates are processed at the temperature at which they come from the producing unit. Normally this temperature range is from 80 to 150 F. Due to their low viscosity and density, temperature is not a critical variable, although coalescence proceeds somewhat more rapidly at the higher temperatures. In some cases distillates saturated with water are cooled prior to coalescence so that part of the water of solution may be precipitated in the process.

For smooth and efficient operation, temperature should be held constant because sudden rises in feed temperature tend to upset the process. The hotter oil entering the lower part of the vessel is lighter and tends to displace the colder and heavier oil in the top of the vessel, resulting in so-called thermal agitation. Temperature drops have the effect of producing smooth piston-type flow, and the coalescing efficiency is generally at its best during periods of gradual decline in feed temperature. These effects of changing temperature necessitates insulation of process vessels, as heat losses from the vessel become excessive in cold weather.

The fresh cold crude oil first receives heat by passing through a series of heat exchangers, where the heat of hot product streams is recovered. Then it goes to the process vessel. Heating the crude aids the process in several ways. Viscosity is reduced, which not only aids coalescence and precipitation but enables more efficient contact with the injected water. In addition, waxy constituents containing both sediment and brine are melted and dispersed, producing a homogeneous mass.

Conductivity of crude oil increases with temperature, and above 250 F this increase is very rapid. Operating at temperatures much higher than 250 F consumes excessive power and in some cases causes the applied voltage to drop below the optimum potential for efficient coalescence. Desalting vessels are also insulated to prevent high heat loss.

About the Authors

David E. Jackson

Jack C. Scott

David E. Jackson is a process engineer and technical sales representative for Howe-Baker Engineers, Inc. He is at present the company's technical representative in London, where his duties include sales, engineering studies, service work and startup of electrical coalescing equipment. After receiving a BS in Chemical Engineering from Queens University, Kingston, Ont., in 1955, he worked as a process engineer with the Lago Oil & Transport Co., Ltd., Aruba, Netherlands Antilles. In 1959, he returned for graduate work at the University of Oklahoma, receiving an MS in Chemical Engineering in June 1960. He is a registered professional engineer in Texas.

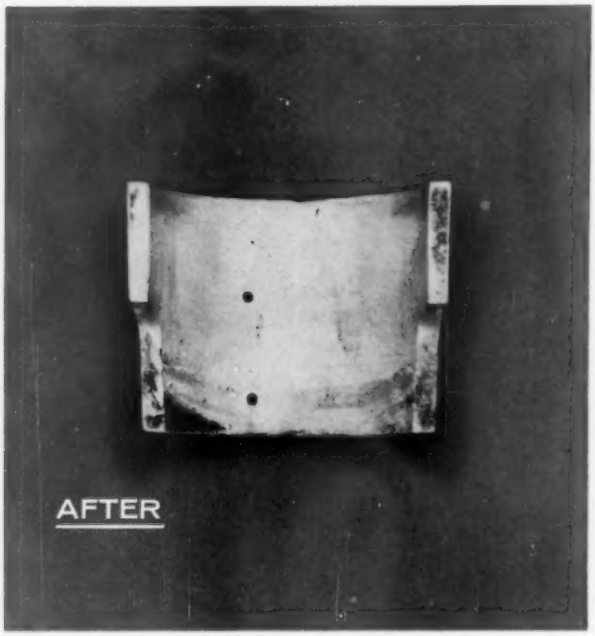
Jack C. Scott is a process engineer for Howe-Baker Engineers, Inc., Tyler, Tex., where his responsibilities include engineering studies in desalting and distillate treating, process design, installation and startup of electrostatic coalescing equipment and technical field service. He was graduated from Texas Technological College in 1951 with a BS in Chemical Engineering. After a tour of duty with the U. S. Army Corp of Engineers he returned to Texas Tech for three semesters of graduate work. Prior to joining Howe-Baker he was a chemical engineer at Gulf Oil's Port Arthur, Tex., refinery.

(This article is based on material originally presented at the Cleveland meeting of the American Institute of Chemical Engineers, May 7-10, 1961.)

■

Du Pont Petroleum Chemicals News

Number 110 in a series of bulletins for the Petroleum Industry OCTOBER • NOVEMBER 1961



Du Pont's multifunctional additive, DMA-4, cleans carburetors and keeps them clean

Carburetor detergency is a striking example of the performance values you can add to gasoline with Du Pont DMA-4.

The carburetor throat liner you see above illustrates how this additive cleans up power-robbing deposits.

On the left, the liner is coated with residue after exposure to an untreated premium gasoline, under severe test conditions. On the right is the same liner after only two hours additional operation under normal operating conditions using the same gasoline treated with DMA-4 at a concentration of 10 pounds per thousand barrels.

Results of other tests have demonstrated that six pounds of DMA-4 per 1,000 barrels of gasoline will prevent deposit accumulations even under the severe conditions utilized to develop the "before" build-up shown above.

The "clean – keep clean" detergency action of DMA-4 is, however, only one of the performance values offered by this Du Pont additive. DMA-4 also offers:

- *Anti-stalling properties.* DMA-4 sets up a protective film that makes throttle plates and other internal surfaces water repellent, thus preventing stalling due to ice formation on cool, damp days.
- *Rust prevention.* The protective film also protects metal surfaces (engine parts as well as pipelines and storage tanks) from corrosion.
- *Phosphorus credit.* DMA-4 contains phosphorus compounds of the type helpful in suppressing surface ignition and spark plug fouling caused by combustion chamber deposits. The concentration of other phosphorus additives can, therefore, be reduced proportionately to obtain minimum treating costs.

Descriptive Bulletin Available

A product bulletin describing DMA-4 is available. To obtain your copy, and to find out how DMA-4 may add new performance and sales values to your gasolines, contact your Du Pont Petroleum Chemicals Division representative.

How you gonna keep 'em . . . ?

Keeping your "down on the farm" petroleum customers may depend on a lot of variables.

To help you understand the

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Du Pont Petroleum Chemicals News

(continued—How you gonna keep 'em . . .)

farmer-buyer of gasoline, we have extracted facts pertaining to farmers and their buying habits from our nationwide "Profile of the Motorist" survey.

These data are available to you in a new break-out report entitled "The Farmer".

Contents of this report include such subjects as credit card vs. charge accounts, loyalty to a single station, and the farmer's experiences with trading stamps and price wars.

Copies of "The Farmer" summary are available to interested parties in the oil industry as a Du Pont service. For your copy, get in touch with your Du Pont Petroleum Chemicals representative.

SEATTLE DISTRICT MANAGER

ROBERT E. HOLETON is District Manager of our Seattle office.

Under the watchful eye of an uncle who "insisted that I must learn something about everything," Bob spent his early years at summer jobs that ranged from helping to train racehorses to printing, deep-sea diving and sand-hogging.

In 1933, he came to Du Pont after completing premedical requirements. Bob continued his schooling while working, finishing as an organic chemist at Temple University in 1943. He started as a technician in our Eastern Laboratory, was progressively promoted to higher responsibilities in eight Du Pont Laboratories, and joined the Petroleum Chemicals Division as a sales service representative in 1949. He has been Seattle District Manager for seven years.

His technical background and research experience have served Bob well in helping petroleum refiners in the Northwest through his knowledge of antiknocks and other petroleum additives.

Bob and his wife, Rachel, live in Bellevue, Washington. They have five children.

The show about the road is now on the road

Every road in America leads to adventure.

This, in seven words, is the theme behind one of the oil industry's latest travel development tools – Du Pont's half-hour color movie, "Highway Holiday."

"Highway Holiday" is a 16mm version of the Cinemascope feature "Down the Road," which is now being distributed to theaters across the nation by 20th Century-Fox. "Holiday" is designed for non-paying showings to any interested group. Both films are part of Du Pont's marketing services to the oil industry.

"Highway Holiday" takes the audience to all corners of the American continent – from the sweeping highway across the Painted Desert to a historic old village in New England, from the gleaming sands of Daytona to the majestic mountains of Canada, from Quebec to Mexico.

All this travel has a meaning. "Highway Holiday" will encourage a greater appreciation of the heritage and beauties of America, and stimulate motorists' interest in seeing them first-

hand through the convenience and comfort of the family car.

Prints available

You can obtain prints of "Highway Holiday" for showing to clubs and other groups, or for local television use. The film is intended to provide you, as a marketer of gasoline and other oil products, with a *broad* "expand-the-demand" promotion, as a backdrop for your own travel development activities.

For further information, contact your Du Pont Petroleum Chemicals representative.

Railroad learns what happens when it stops using FOA-2

Not long ago, a leading railroad tried an interesting experiment:

They had been using Du Pont FOA-2 to keep diesel locomotives free from filter plugging and other potential fuel problems. At one point, however, they felt that the sludge problem wasn't severe enough to justify continued use of FOA-2 in certain fuels. They decided to find out.

Shortly after the test started, several cases of fuel incompatibility were reported for the first time; filter plugging increased; and it was quickly found that the cost to replace the filters was more than the cost of the FOA-2 they had previously used.

Today, this railroad is once more using FOA-2 to reduce sludging and keep filters clear. Costs and maintenance worries are once more back in line.

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San Francisco 4, California–		
111 Sutter St.	415	EX 2-1934
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Du Pont Antiknocks and other Petroleum Additives

OVER

ADVERTISEMENT–Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

Printed in U.S.A.

by Dr. J. M. Marchello

Mathematics Workshop

Calculus / Part 2

CLIP/FILE

PETRO/CHEM

B. Rules and Elementary Forms of Integrals

Five general rules which are frequently useful in reducing more involved integration problems to simpler ones are:

1. The value of the integral from a to b is the negative of the value of the integral from b to a.

$$\int_a^b f(x)\,dx = -\int_b^a f(x)\,dx$$

2. The integral of a constant, C, times a function, $f(x)$, is C times the integral of $f(x)$.

$$\int_a^b C\,f(x)\,dx = C\int_a^b f(x)\,dx$$

3. The integral of the sum of two functions is equal to the sum of the integrals of the two functions.

$$\int_a^b [f(x) + g(x)]\,dx = \int_a^b f(x)\,dx + \int_a^b g(x)\,dx$$

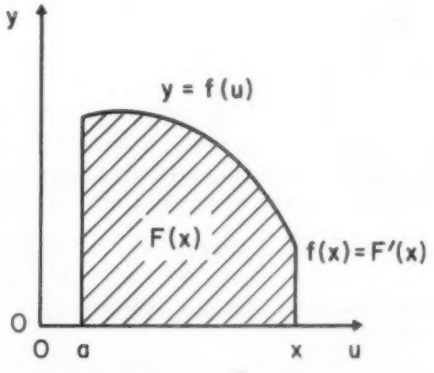

FIG. 1A. The integral as a function of the upper limit.

4. The integral of a function over two adjacent intervals is equal to the integral over the combined interval.

$$\int_a^b f(x)\,dx + \int_b^c f(x)\,dx = \int_a^c f(x)\,dx$$

5. The value of an integral does not depend upon the particular name, x, chosen for the independent variable in $f(x)$.

$$\int_a^b f(x)\,dx = \int_a^b f(u)\,du$$

In other words, changing the name of the coordinates in the system to which the graph of the function refers does not alter the area under the curve.

The operation of integration has been reduced to an essentially mechanical procedure by the compilation of tables of known integral forms. In many cases to carry out an integration, all that is required is to find the standard form which corresponds to the

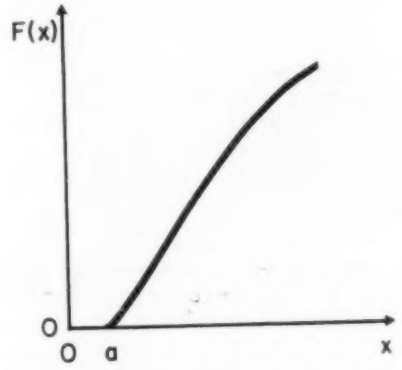

FIG. 1B. The integral vs its upper limit.

expression to be integrated. A few of these forms are:

$$\int dx = x + C \quad . \quad . \quad . \quad . \quad (1)$$

$$\int v^n dn = \frac{v^{n+1}}{n+1} + C \quad . \quad (2)$$

$$\int \frac{dv}{v} = \ln v + C \quad . \quad . \quad . \quad (3)$$

$$\int e^v dv = e^v + C. \quad . \quad . \quad (4)$$

$$\int \sin v dv = -\cos v + C. \quad (5)$$

A great number of forms of this type have been worked out and are available in the literature.

C. Fundamental Theorem of Calculus

An interesting approach to differentiation arises from the fundamental theorem of calculus.

Consider the integral of a function, $y = f(u)$, from the fixed lower limit, a, to the variable upper limit, x (Fig. 1).

$$F(x) = \int_a^x f(u)\, du. \quad . \quad . \quad (6)$$

The integral function, $F(x)$, is the area under the curve $y = f(u)$ from the point $u = a$ to the point $u = x$. An integral with a variable limit is said to be an indefinite integral.

The fundamental theorem of calculus states that the derivative of the indefinite integral, Eq. 6, as a function of x is equal to the value of $f(u)$ at the point x:

$$F'(x) = f(x) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

That is, the process of integration, leading from the function $f(x)$ to $F(x)$ is inverted, undone, by the process of differentiation applied to $F(x)$.

Solution to Problem 12

Rearranging the equation for linear lag in a control system and integrating:

$$\int_0^{P_2} \frac{dP_2}{(P_1 - P_2)} = \int_0^{\theta} \frac{d\theta}{T} \quad . \quad (12\text{-}2)$$

The standard form for integrating the left side of Eq. 12-2 is given in many handbooks and textbooks on calculus:

$$\int \frac{dx}{ax + b} = \frac{1}{a} \ln (ax + b) + C$$

Applying this expression, where $a = -1$,

$$\int_0^{P_2} \frac{dP_2}{(P_1 - P_2)} = \Big[-\ln (P_1 - P_2) \Big]_0^{P_2} =$$

$$\ln \frac{(P_1)}{(P_1 - P_2)}$$

The final integrated form of Eq. 12-2 is

$$\ln \frac{(P_1)}{(P_1 - P_2)} = \frac{\theta}{T} \quad . \quad . \quad (12\text{-}3)$$

This equation indicates that a plot of $\ln (P_1/P_1 - P_2)$ vs θ will yield a straight line with a slope of 1/T.

The form of Eq. 12-3 that gives P_2 directly is

$$P_2 = P_1 (1 - e^{-\theta/T}) \quad . \quad . \quad . \quad . \quad (12\text{-}4)$$

This type of expression does not lend itself to straightforward use of semi-log graph paper. The form which does is

$$\frac{P_1}{(P_1 - P_2)} = e^{\theta/T} \quad . \quad . \quad (12\text{-}5)$$

To quickly determine from response data whether or not a control system exhibits linear lag, calculate the quantity $P_1/(P_1 - P_2)$ and plot it vs θ on semi-log paper. If the data fall on a straight line, the system has the properties of linear lag.

Problem 13, Entropy Change on Heating

Calculate the entropy change per unit mass for heating water from a liquid to a vapor. Start with the liquid at 32 F and finish with the vapor at 600 F. Use the following information:

$C_p = 1.00$ Btu/lb F; water
$\Delta H_{ev} = 970$ Btu/lb; latent heat
$C_p = 8.22 + 0.15 \times 10^{-3}\, T + 1.34 \times 10^{-6}\, T^2$; cal/g mole K, steam, T in K.

Assume reversible processes and use the relations

$$S_2 - S_1 = \int_{T_1}^{T_2} \frac{C_p}{T}\, dT \quad . \quad (13\text{-}1)$$

for the change in entropy with temperature of a single phase at constant pressure, and

$$S_v - S_l = \frac{\Delta H_{ev}}{T}. \quad . \quad . \quad (13\text{-}2)$$

for the change in entropy on vaporization at constant pressure.

Dr. J. M. Marchello is professor of chemical engineering at the University of Maryland, College Park, Md.

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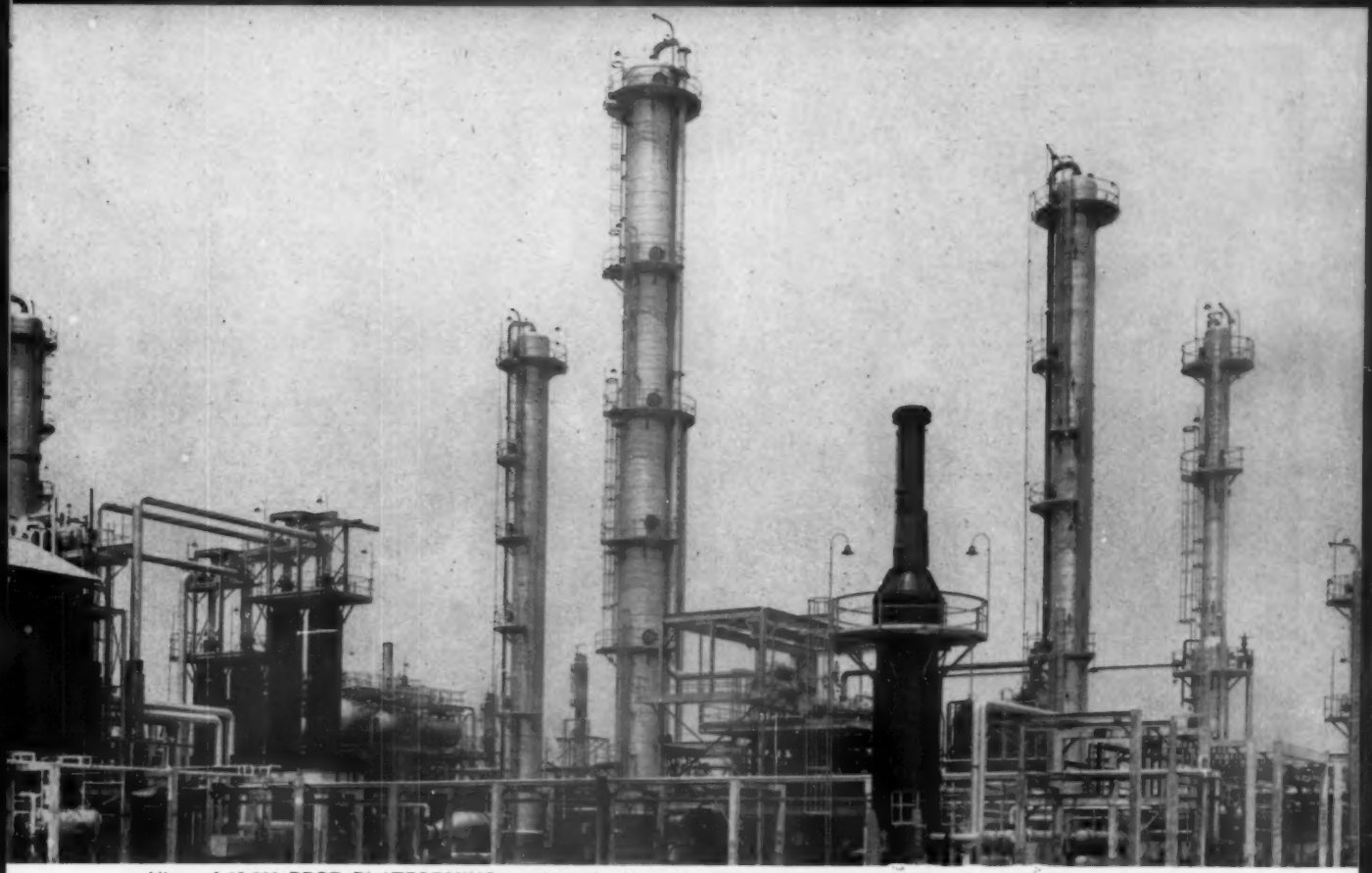
RELIABILITY

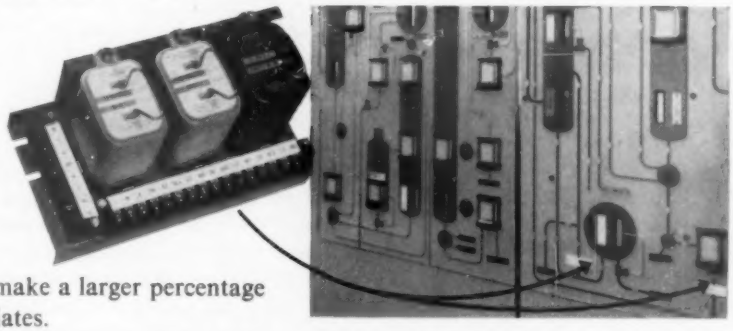
CHOSEN BY UOP AND SHELL



View of 16,000 BPSD PLATFORMING® unit at the Houston, Texas, Refinery of SHELL OIL COMPANY, licensed by UNIVERSAL OIL PRODUCTS COMPANY and designed in conjunction with Shell.

DEPENDABLE MONITORING SINCE INSTALLATION IN 1956

The Panalarm remote system is particularly suited for central graphic control panels used in most refining processes. Back-lighted nameplates are conveniently located in the process flow and actuated remotely by hermetically sealed alarm relays mounted in strip chassis or adapter cabinets. Meets Class I, Group D, Division 2 requirements.



Panalarm Annunciators warn Platformer T.M. operators when undesirable conditions develop at critical points by illuminating appropriate translucent plates on this graphic control panel, only a portion of which is shown. When desired, a simultaneous audible signal also attracts attention.

The Platforming® process enables a refiner to make a larger percentage of top quality gasoline and petrochemical intermediates.

Every major oil and petro/chem firm uses reliable Panalarm Annunciators.

Panalarm maintains a large staff of annunciator engineering specialists to assist with special annunciator design and application problems. For your specific annunciator requirements, contact Panalarm; sales and engineering offices are in all principal cities. Your inquiry will receive prompt attention.

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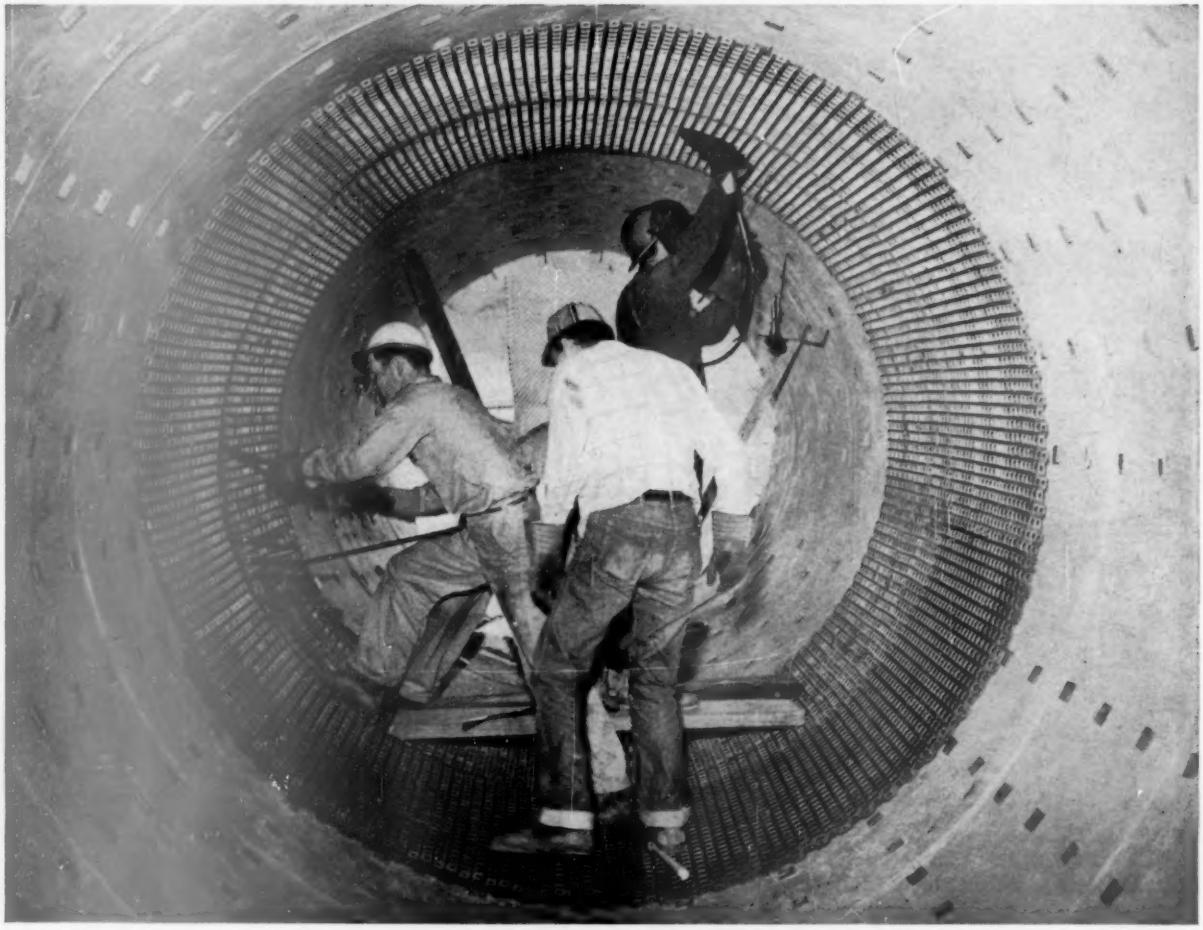
Refractory insulating concrete protects catalyst lines against erosion



Gunite Contractor: J. A. McCollum, Inc., Marlton, N. J. Castables: Kaiser Refractories & Chemicals Div.

In this catalyst line at a large Gulf Coast refinery, steel mesh is being welded into place over a 3-inch lining of refractory insulating concrete made with LUMNITE calcium-aluminate cement. Over the mesh, a 1-inch thickness of high-strength castable will be gunited, providing a 2-component refractory concrete lining that will resist severe erosion and abrasion caused by catalyst fines. Monolithic refractory concrete linings eliminate troublesome mortar joints. They are easily placed, conforming to any contour. Castables are recommended because they are simply mixed with water and placed – concrete reaches service strength in 24 hours. Castables containing LUMNITE cement are available from leading manufacturers of refractories for a variety of applications in refinery equipment. For information, write Universal Atlas Cement, 100 Park Avenue, New York 17, N. Y.

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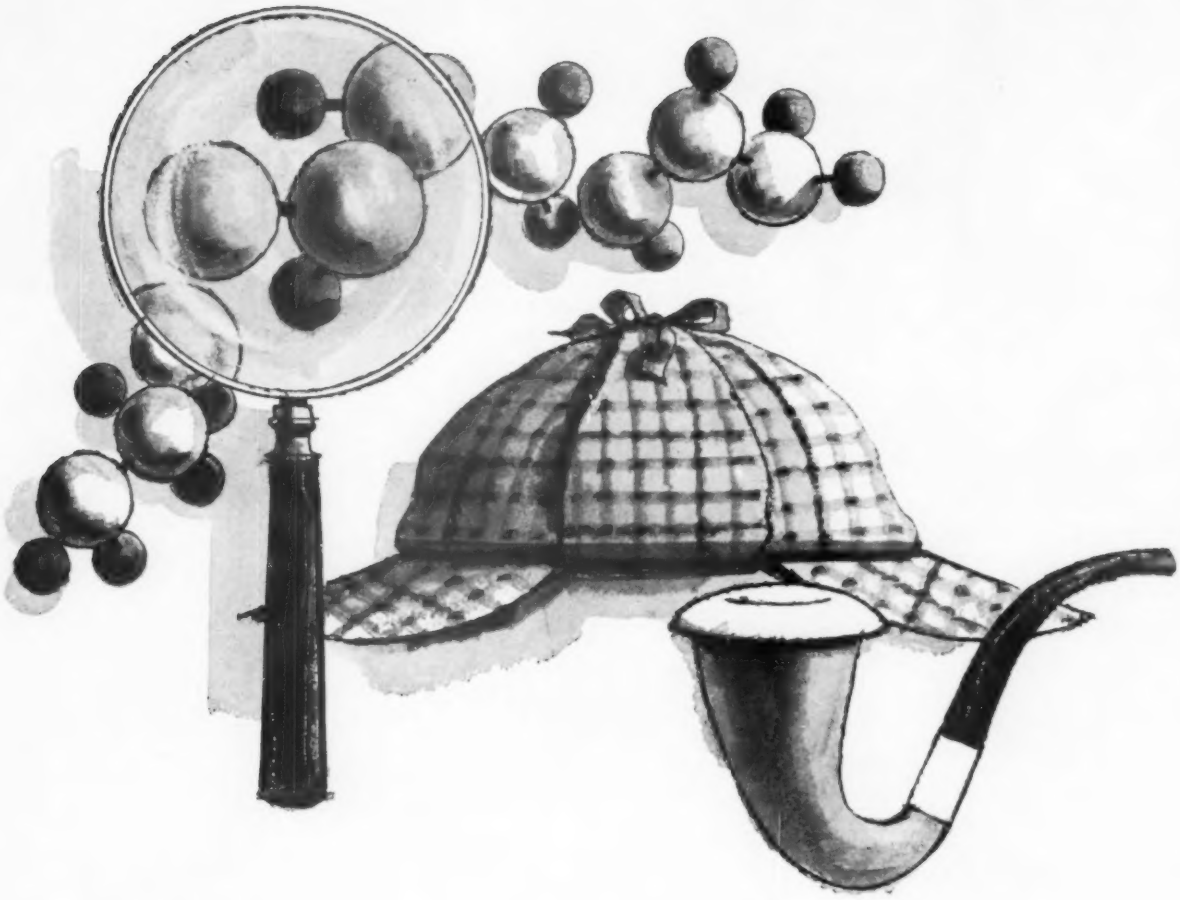

THE CASE OF THE MISSING CARBON ATOMS

Sticky problem. Clearly not a case of theft. No evidence of foul play, either.

Whole thing started with "n-paraffins"—family of methane molecules. N-paraffins appear in crude oil and source rock—sediments in which oil was formed. Shifty, though; also crop up in rock which never harbored any oil. Very misleading to oil-hunters. How to tell one kind of rock from the other?

One piece of evidence to go on: N-paraffin molecules very careless about their make-up. Some have an *even* number of carbon atoms; others, an odd number. H-m-m-m. Any telltale ratio between the number of "even" and "odd" molecules?

One way to find out. Count the carbon atoms.

Ever count atoms? Easier said than done. Invisible, you know. Takes all kinds of latest, most advanced scientific techniques—fractionation, spectroscopy, radiocarbon dating, quick-freezing of cores. That sort of thing. Calls for first-rate scientists. Socony Mobil assigned job to task force of scientists under physicist Ellis Bray. Resourceful man, Bray. Persistent, too. Had to be—counted carbon atoms in *quadrillions* of n-paraffin molecules.

Job took lots of patience, correlation. This and a bit of shrewd deduction led science fellows right to the key. Simply this: If your count shows almost exactly as many molecules with *even* number of carbon atoms as with *odd* number, your molecules come from source rock. Good hunting ground for oil. But if "odd" molecules outnumber "even" by as little as 20 in 100, sediments not oil-bearing.

Elementary, of course. But good thing to apply to oil exploration. Can sometimes mean difference between success and failure. Big difference. Tantalizing, though, this discovery. Gives new clues to even deeper mystery—how oil formed in first place. Really *big, that one. Way it goes in this research thing.*

Lots of chaps working alongside Ellis Bray in Mobil's $25,000,000-a-year research program. Some 1,500 of them. Both sexes. Turn imagination into ideas, ideas into better products and processes. Clever.

Good thing, this probing frontiers of science. Not only for Mobil, but for everyone who does business with Mobil—customers, employees, licensees, investors.

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For Further Information on Advertised Products See Reader Service Card

HPI Equipment

Alarm Monitoring System

Multi-channel high speed alarm system automatically monitors hundreds of points in complex industrial operations to detect off-normal operation and initiate remedial action within seconds. High and low alarm limits are predetermined for each point to be monitored, and these points are stored in the system's memory. It examines each point sequentially and compares value of the quantity at that point with the predetermined limits. System is assembled from standard modular components. Low speed scanning units scan at rate of 10 points per sec and use electro-mechanical switching, while high speed units scan at rate of 1000 points per sec and use electronic switching. *Control Equipment Corp.*

Circle number (41) on reply card

Atomizing Oil With Steam

Bulletin on steam atomizing oil burners, Types SAR and SAL, gives engineering data showing how the units provide efficient means for atomizing oil by means of steam, compressed air or natural and by-product gases under pressure. Five sizes are offered, with rated capacities from 10 to 600 gph. Units permit use of four oil spray and flame patterns — hollow cone, long solid circular jet, solid cone and flat. *National Airoil Burner Co.*

Circle number (42) on reply card

Centrifugal Compressor

New single-stage centrifugal compressor, Model HTP, is designed for applications requiring working pressures from 50 to 500 psig and operating temperatures to 800 F. Models are available with inlet capacities from 500 to 5000 cfm. Bulletin SSC-161 gives more details. *Roots-Connersville Blower, Div. of Dresser Industries, Inc.*

Circle number (43) on reply card

Better Sealing Plug Valve

Twin Seal Model C non-lubricated plug valve provides bubble-tight seal at upstream and downstream ports with a body bleed for positive checking of the seal. Patented plug assembly, with two replaceable seating segments, avoids abrasive contact of seating surfaces. Available in five pressure ratings: 150-psi, for 2 through 16-in. pipe sizes; 300-psi, for 2 through 12-in. sizes; 600-psi, for 2 through 10-in. sizes; 900-psi, for 3 through 8-in. sizes, and 1500-psi, for 2-in. pipe. Stocked in standard cast steel grades, valve can also be ordered in all highly corrosive resistant metals. *General Valve Co., Inc.*

Circle number (44) on reply card

Centrifugal Pump Data

Type GBH close-coupled end-suction centrifugal pumps are subject of new Bulletin 108. Capacities range up to 1600 gpm, heads to 330 ft and temperatures to 250 F. Especially designed for high efficiency and low horsepower requirements, pumps are suitable for cooling towers, boiler feed, condenser circulation and general liquid services. Interchangeable mechanical seal or packing inserts assure versatility of application. *Aurora Pump Div., New York Air Brake Co.*

Circle number (45) on reply card

Chromatograph Accessories

Precision measuring equipment for chromatography is detailed in new Catalog H-9a. Includes microliter syringes, gas-tight syringes, fraction collector, admission probe and vacuum probe. *Hamilton Co.*

Circle number (46) on reply card

Compression Tube Fittings

Newly issued 20-page catalog presents 25 items of Ridg-lok tube fitting line with illustrations and dimensions. Fittings are available in 316 stainless steel for corrosion resistance and in brass for instrumentation, air, oil, water and coolant lines. Sizes to fit tubing with from 1/16 through 1 in. OD. *Parker-Hannifin Corp.*

Circle number (47) on reply card

Contact Your Audience

Professional advancement booklet "Public Speaking: Impact a Result of Contact" stresses establishing an area of contact with an audience and tells how to do it. *Western Supply Co.*

Circle number (48) on reply card

Controls 7 Load Circuits

Up to seven individual load circuits can be controlled by new ATC Series 305-B timer. All load connections are internally wired independently to a 14-point terminal block. *Automatic Timing & Controls, Inc.*

Circle number (49) on reply card

Corrosive Fume Exhausts

How to handle corrosive fumes with fans, air washers and exhaust systems made of polyvinyl chloride is described in 36-page Catalog F. Complete chemical-resistance data are tabulated for normal and high-impact PVC and various metals, covering all types of chemicals and their resistance ratings. *Industrial Plastics Fabricators, Inc.*

Circle number (50) on reply card

Data on Acids, Anhydrides

New 48-page booklet provides comprehensive data on properties and uses of acetic, propionic, butyric, 2-ethylbutyric, 2-ethylhexoic, acrylic, sorbic, valeric and isodecanoic acids and acetic, propionic and butyric anhydrides. *Union Carbide Chemicals Co.*

Circle number (51) on reply card

Data on Conductivity Cells

Industrial electrolytic conductivity cells and mountings are subject of a new data sheet, NS6(1). Descriptive material and tables aid in selection of the proper Teflon or Penton plastic cell for a variety of applications. *Leeds & Northrup Co.*

Circle number (52) on reply card

Draftette Sketch Kit

T-square, triangle and protractor are all combined in one compact, self-contained binder housing in the Draftette sketch kit, a new portable drafting machine. The portfolio fold kit includes the drafting instrument, with 3 by 5-in. or 4 by 6-in. scale and 180-deg protractor,

pad of 50 sheets of 8½ by 11-in. drawing paper and pencil. Overall dimensions are 9½ by 13 by 1½ in. Weight is 1½ lb. Priced at $8 for complete unit with the small scale and $9 with the larger scale. *Draftette Co.*

Circle number (153) on reply card

Distillation Equipment

New brochure on distillation equipment for the process industries has special section devoted to distillation columns. *Struthers Wells Corp.*

Circle number (53) on reply card

Distillation Handbook

Complete series of articles on "Distillation . . . In View of Modern Developments," published intermittently in Petro/Chem Engineer from May 1959 through July 1961, soon will be available as 64-page reprint. We will bill you for $1 when we mail your copy. *Petro/Chem Engineer.*

Circle number (54) on reply card

Dry Face Shaft Seal

Circo-Flex seal, new dry face mechanical shaft seal running in the pumpage, requires no stuffing box gland water, lubrication or cooling and will accept stuffing box pressures to 100 psi, product temperatures to 600 F and shaft speeds to 3600 rpm. Special materials for use in corrosive service include carbon steel, 316 stainless steel, Inconel, titanium and tantalum. *Donley Products, Inc.*

Circle number (55) on reply card

Ductile Iron Pipe Fittings

Complete line of ductile iron pipe fittings is detailed in new 12-page Catalog 3PF. Included are available stock sizes and prices for ductile screwed fittings with ratings from 300 to 2000 psi; Pipe Lock couplings for 400 and 800 psi service, flanges and flanged fittings in the 150 and 300 psi classes, and hexagon bushings and plugs. *Kuhns Bros. Co.*

Circle number (56) on reply card

Engineered Cleaning Program

Cleaning and pickling of new petroleum processing equipment is discussed in Service Bulletin 51-B. *Oakite Products, Inc.*

Circle number (57) on reply card

Explosion-Proof Switches

Explosion-proof diaphragm pressure switches with set and re-set accuracy of ±½% can be adjusted externally. In the low setting they will actuate at 0.1 in. mercury with proof (test) pressure to 10 psi. In higher ranges they will go up to 300 psi proof (test) pressure at settings to 150 psi. Standard pressure connection is ¼-in. npt female pipe fitting. Single setting and dual control models are available. *Barksdale Valves.*

Circle number (58) on reply card

Facts on Fuel Oil Heaters

Technical data on two new types of fuel oil heaters is given in Bulletin 200. One is a tank suction type heater which is installed on storage, blending or working tanks with open end of the heater extending into the tank. Other style is a line-type heater which is mounted entirely outside the bank in the pipeline. It is used either to preheat liquids to proper temperature for further processing or to overcome temperature losses in a long line. *Brown Fintube Co.*

Circle number (59) on reply card

Fast, Powerful Actuator

New 20,000 Series actuator offers extremely fast speed, high frequency response, good positional accuracy and large thrust. Custom designed for specific applications, the Model EHA-1 provides means of converting a suitable electrical signal from control station to a powerful hydraulic force. Responsive to minute rapid changes in electrical signals, it delivers instantaneous action while remaining inherently stable under adverse operating conditions. *Annin Co.*

Circle number (60) on reply card

Flip Lever; Switch Control

Automatic-manual control transfer is achieved by flip of a lever, without need for matching pressures, with PneumatiK Tel-O-Set 4-in. indicating, recording and controlling devices. Included are 1 and 2-pen strip chart recorders with and without control, single and 2-station recording cascade control, 1 and 2-point indicators with and without control, a proportional plus reset controller and a proportional plus reset plus rate controller. *Brown Instruments Div., Minneapolis-Honeywell.*

Circle number (61) on reply card

Flo-Eye Indicator Alarm

Construction and operating details for new Flo-Eye indicator alarm, a flow indicator that incorporates an adjustable alarm integrally mounted in a weatherproof housing, are contained in new bulletin supplement. *Schutte and Koerting Co.*

Circle number (62) on reply card

. . . one of a series presented by Western Supply Company, Tulsa, to improve the "I. Q."* of engineers . . .
(*"Income Quotient")

Facts-of-Life for successful engineers must include attitude, self-appraisal, vision, understanding, respect, relaxation and "happiness"

Achieving "success" and/or "happiness" in your professional and personal future won't just "happen," regardless of how diligently you apply yourself to your daily tasks, unless your efforts are coordinated along specific paths of endeavor. Your life as an engineer must be counterbalanced by your life as an individual — because "engineers ARE human," despite comment to the contrary.

The engineer reacts to the same human stimuli and motivations as the man in the accounting division, the sales department, the repair and maintenance crew, the general office force, or in the management division. All are motivated to varying extents by the same drives for recognition, self-respect, material progress, functional importance, personal pleasure, financial stability — and "security," however, the latter is translated.

The fact of the matter is no longer "theoretical," it is accepted, proven, practical "common-sense": to accomplish either or both of these achievements, your pursuit of "happiness" and/or "success" must have (a) ambition, (b) definition, (c) purpose, (d) direction. It is a life-long pursuit, subject to many detours and changes. In the pursuit itself, however, will be found much of its own reward.

One of our basic problems seems to stem from our relationships with *others* — our reactions to the drives of other people and their reactions to ours, because, like it or not, we *are* affected by other people, and they are affected by us.

Professionally, we are affected by our superiors, associates and subordinates — both technical and non-technical. Personally, we are affected by our family, our relatives and our friends — on and off the job. Our object then, is to ascribe to both our professional and personal life those qualities and human attributes which bring professional success and personal happiness. *We must develop a formula for living.*

This limited space, of course, does not permit a full look at this most complex of subjects, but a more complete treatment of human relations in engineering is found in our Booklet E-6, "Facts-of-Life," available free upon request. Write for your copy to WESTERN SUPPLY COMPANY, HEAT EXCHANGER DIVISION, P. O. BOX 1888, TULSA, OKLA.—and remember, *our* success and happiness stem partially from the heat exchangers in *your* future.

These "extras" make Sumpmaster cost less in the long run!

A heavy-duty, pre-engineered pump, BJ Sumpmaster has the "extras" in design and materials that save you money in the long run. High heads to 400 feet at low speed mean longer service, less wear and down time. Superior Meehanite castings used throughout—semi-open impellers are quickly adjustable for wear. Two-piece headshaft for ease of inspection and maintenance. Entirely self-contained for fast installation. High efficiency—non-overloading HP characteristics over the entire capacity range to 3500 gpm. Compact and self-priming, with choice of oil or self-lubricated shafting... packing or mechanical shaft seals. Sumpmaster is designed for rugged service in sump, circulating, cooling, booster and general industrial pumping applications—and it's now available from stock for *immediate delivery.*

BYRON JACKSON PUMPS, INC.
SUBSIDIARY OF BORG-WARNER CORPORATION
P.O. Box 70, Lawrenceburg, Indiana
P.O. Box 2017-A, Terminal Annex, Los Angeles 54, California

BYRON B-W JACKSON

4-Pen Dynamaster Recorder

Versatile, space-saving 4-pen Dynamaster recorder simultaneously records four independent variables. Plug-in range change cards hold all circuitry associated with a given range; thus, changing range becomes a quick, easy operation. Four motor drives power the pens and slidewires. There is ample torque for many auxiliary functions. Bulletin P1289 gives specifications. *Bristol Co.*

Circle number (63) on reply card

Instrumentation Symbols

Application bulletin "Suggested Flowsheet Instrumentation Symbols" shows symbols used by instrument and process engineers in drawing process flow sheets and schematic control systems. Generally they follow recommended practice outlined by Instrument Society of America. *Fischer & Porter.*

Circle number (64) on reply card

Heat-Les Dryers Described

Specifications and capacities of Trinity's Heat-Les dynamic desiccant dryers are contained in newly revised catalog. Heat-Les dryers employ no heaters for reactivation of the desiccant beds, while providing dewpoints below —100 F for compressed gas or air. *Trinity Equipment Corp.*

Circle number (65) on reply card

High Pressure Exchanger

New multi-fintube double pipe heat exchanger with hairpin-type shell is suited for high pressure operations up to 6000 psig in the tubes and 1800 psig in the shells. One multi-fintube unit, with its higher heat transfer capacity, can replace as many as four conventional units, thus permitting substantial reduction in cost of sizing many jobs. Bulletin 112 gives full details. *Brown Fintube Co.*

Circle number (66) on reply card

High Pressure Manifold

New 3-valve manifold incorporating two block valves and one bypass valve handles pressures to 2000 psi with minimum volume. The hand-operated, packless unit, available in 303 or 316 stainless steel, is extremely compact and has ¼-in. OD tubing connections. Also made in 1, 2, 4, or 5-valve styles. *G. W. Dahl Co.*

Circle number (67) on reply card

How to Blend Asphalt

Asphalt production and distribution problems such as blend rates and temperatures, selection of diluents, control of additives, remote registration, tank storage and many others are discussed and solutions recommended in new booklet "It's a Fact: There's a Better Way to Blend Asphalt." *B-I-F Industries.*

Circle number (68) on reply card

100 Thermowell Designs

Some 100 basic designs of thermowells for the protection of temperature sensing devices are described in Catalog TT-301. Standard materials offered include 304SS, 316SS, 347SS, 410SS, monel, inconel, nickel, steel, Carpenter 20, hardware bronze and Everdur 1010, with others available on special order. *Trinity Equipment Corp.*

Circle number (69) on reply card

Handling Methyl Chloride

Long-time manufacturer of methyl chloride tells how to store, transfer and measure CH_3Cl and other liquefied gases in a 14-page bulletin. *Ansul Chemical Co.*

Circle number (70) on reply card

Insulating Fire Brick

Two new fire brick for use in prepared atmospheres are discussed in illustrated brochure, IN-294A. Designed primarily for resistance to CO, H_2 and CH_4 atmospheres, JM-23 is recommended for service to 2300 F and JM-20 to 2000 F. Both are suitable for direct exposure as well as back-up insulating purposes, and both are considerably lighter in weight than the brick they supersede, while having high load bearing strength. *Johns-Manville.*

Circle number (71) on reply card

Insulation Thickness Data

Newly expanded 180-page manual "How to Determine Economic Thickness of Insulation" contains 17 graphs and 126 pages of tables. Originally prepared by Union Carbide Chemicals Co. and West Virginia University College of Engineering. $8. *National Insulation Manufacturers Assn.*

Circle number (72) on reply card

Lattice Braid Packings

Revised edition of Lattice Braid Packing brochure (AD-131) supplies updated technical data and gives information on new Style 5875 packing, made from long fiber asbestos yarn with Teflon impregnation. *Garlock Inc.*

Circle number (73) on reply card

Liquid Level Transmitter

Accuracy of mechanical measuring and efficiency of electronic signalling are teamed in a new liquid level transmitter that transmits d-c signals proportional to level varia-

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ANY TEMPERATURE

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EMERGENCY PIPE CLAMPS for safe, sure lasting repair of splits and rust holes in pipe. No pressure too high. Anyone can apply in a few moments. Made in all sizes, ½" to 12", for steel and C. I. pipe. Stocked by practically all oil supply stores.

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COLLAR LEAK CLAMPS—for oil and gas lines. Gasket is sealed by gasket container rings—pressure is sealed in . . . air, moisture and gasket-destroying soil conditions are sealed out. Effective under any pressure. Sizes 2"—13" O.D. incl. In stock at oil supply stores!

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M. B. SKINNER CO.
SOUTH BEND 21, INDIANA

tions. Instrument is readily adaptable to all systems using electronic indicators, recorders or controllers. An LVTD displacement transducer is coupled with a solid state amplifier. Accuracy is within 1%. The electronic signalling device is coupled with a variable displacement measuring element of the type proved most efficient in Masoneilan Series 12000 pneumatic level controllers. *Mason-Neilan Div., Worthington Corp.*

Circle number (74) on reply card

Magnetic Amplifier

A proportional power magnetic amplifier for precise electrical control applications has just been introduced. Coupled with a standard saturable core reactor, the new amplifier is the electrical equivalent of an equal percentage valve, in that a linear change in the system input will produce a percentage change in process power. With commercially available control equipment, the system also can be used to control any mechanical or electrical process where a proportional power curve is required. Unit operates from a 110-v, single-phase, 60-cycle line with 0-5 milliampere input, from any automatic controller installation. Output from the magnetic amplifier is normally 0 to 85 v d-c. *Hevi-Duty Electric Co., Div. of Basic Products Corp.*

Circle number (75) on reply card

Measuring Instrument Data

Compact, easy-to-read V5 gages for indicating draft, pressure, differential gas pressure and temperature and for receiving pneumatic impulses from transmitters are illustrated and discussed in 12-page Bulletin 321.11. *Republic Flow Meters Co.*

Circle number (76) on reply card

Onstream Descaling

Latest materials and methods for onstream descaling of heat exchange equipment are subject of Service Bulletin 29-B. *Oakite Products, Inc.*

Circle number (77) on reply card

Money-Saving Pump Design

Unique design of vertical volute circulating water pumps permits flexible coupling to standard motors instead of expensive high-thrust motors. A carbide bearing and journal are placed within the pump case, between the impeller and packing box, thus drastically reducing impeller overhang. A self-aligning spherical roller thrust bearing, or plate-type thrust bearing, is employed to carry impeller thrust and weight of rotating parts. This arrangement reduces overall height of the pump, minimizes shaft misalignment and vibration and allows the use of standard motors instead of the more costly high-thrust motors. *C. H. Wheeler Manufacturing Co.*

Circle number (78) on reply card

Packaged Hydro-Steam Unit

A compact packaged hydro-steam unit that produces vacuum quickly and at low cost is described in Bulletin 5H-HS. Available in single-stage to five-stage models for any vacuum down to 25 microns Hg absolute. *Schutte and Koerting Co.*

Circle number (79) on reply card

Pipe-Mounted Process Pumps

Type SPM vertical, centrifugal, pipeline-mounted process pumps are introduced in Bulletin 142. Designed for maximum parts interchangeability, pumps have only six functional replacement parts and require no base-plates or foundations. Pump and motor use a common shaft, thereby eliminating need for alignment in the field. *Pacific Pumps, Inc.*

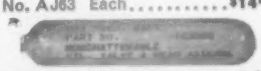
Circle number (80) on reply card

FLUID & GAS PRESSURE TANKS
STAINLESS & CARBON STEEL TANKS
(GOVERNMENT SURPLUS BARGAINS)

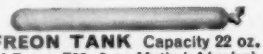
Steel tanks for the handling, storage and transportation of gases, beverages, fuels, hydraulic fluids and other liquids. Stainless steel tanks for corrosive acids and gases.

J-1 PRESSURE TANK Stainless steel, surplus aircraft oxygen tank, 48" long, 24" dia. Rated for 400 P.S.I. working pressure, 18,000 cu. in. vol., 77.9 gal. capacity. ¼" pipe thread fitting at each end. New condition. Shipping weight 247 lbs. F.O.B. Chicago.
No. AJ832.....$99.50

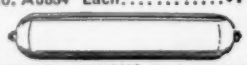
G-1 TANK Stainless steel. Capacity 2100 cu. in. (9 gals.) 450 P.S.I. ¼" pipe thread port at each end. 24" long, 12" dia. Shipping weight 19 lbs. F.O.B. Chicago. (Two for $27.00.)
No. AJ63 Each.....$14.95



NON-SHATTERABLE CO_2 CYLINDER This type of pressure bottle was used by the Armed Forces for inflating life rafts. 18¼" long, 3¾" dia. Has ¼" pipe thread opening at one end. Capacity 2.98 lbs. of CO_2—at 1800 P.S.I. Shipping weight 10 lbs. F.O.B. Chicago.
No. AJ303.....$2.50



FREON TANK Capacity 22 oz. of Freon F22, 6 cc Methyl Alcohol. 18¼" long, 2" dia. ¾" pipe thread opening at one end. Equipped with brass valve. Shipping weight 3 lbs. F.O.B. Chicago. (Six for $8.00).
No. AJ834 Each.....$1.50



D-2 AIR TANK Carbon steel. Capacity 500 cu. in. (approx. 2 gals.) 450 P.S.I. ¼" pipe thread port at each end. 24" long, 6" dia. Postpaid. (Two for $8.50).
No. AJ391 Each.....$4.95

CORNELIUS HIGH PRESSURE (1500-2000 P.S.I.) AIR COMPRESSOR Three cylinder, 3-stage compressor, complete with 27 volt, D.C. 20 amp. motor, with fan. Rated 1500 P.S.I. continuous duty, 2000 P.S.I. intermittent. Pressure switch in base. As released by Air Force, in used, serviceable condition. Covered by our 30 day GUARANTEE. 11½" long, 7" high, 9" wide. Shipping weight 12 lbs. F.O.B. Chicago. Limited quantity.
No. AJ549.....$35.00

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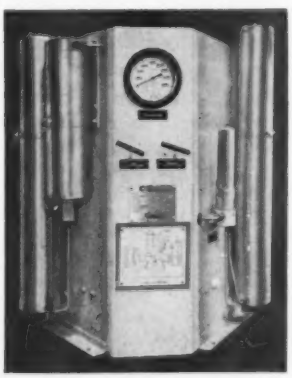

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PRESSURE COMPONENTS, Inc.
3429-D OCEAN VIEW BLVD.
GLENDALE 8, CALIFORNIA

Plastic Light Guard

Protective light guard of Kemlon P, high impact glass-reinforced thermosetting plastic material, resists atmospheric corrosion and also acid and chlorine vapors. Unaffected by temperatures to 350 F. Particularly good for protecting fixtures against swinging pipes and tools. *Keystone Engineering Co.*
Circle number (125) on reply card

Plastic-Lined Y Valve

Flow of corrosive fluids can be safely controlled with new metal, plastic-lined Y-type valves. All interior or wetted parts (inside surface of body, bonnet, stuffing box and the lower stem) are protected by a heavy lining of Penton, Kel-F or Halon, depending on intended service. Bodies usually are of cast carbon steel; however, other alloys are available on special order. Size range is from 1 through 3 in., with dimensions conforming to ASA Standard B16.5 for 150 psi. *Wm. Powell Co.*
Circle number (126) on reply card

Pneumatic Controller Data

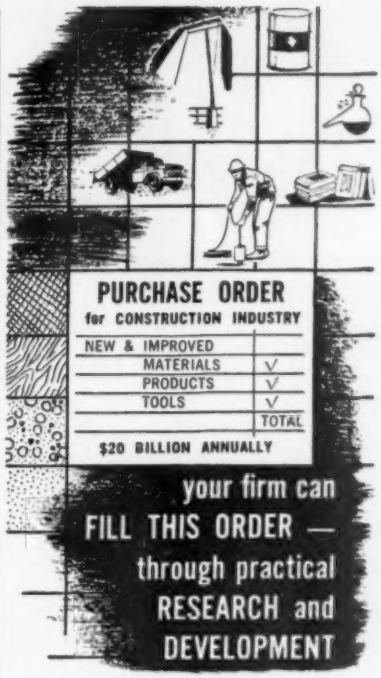
Design features and specifications for new A/D pneumatic controllers are given in Product Bulletin A120.4-4. Block diagrams and cutaway drawings show how unit works and is employed in various applications. *Bristol Co.*
Circle number (127) on reply card

Prevents Sludge Formation

A family of organic dispersives has been specially formulated to minimize adherent sludge formation in boilers and recirculating cooling systems. Selection of a dispersive is based on both physical and chemical examinations of deposits. In choosing a dispersive for boiler use, samples are needed of deposit from feedwater entry zone, deposit from low velocity area such as mud drum and generating tube deposit. For recirculating cooling systems, one deposit and a circulating water sample are sufficient. *Hagan Chemicals & Controls, Inc.*
Circle number (128) on reply card

Process Equipment Catalog

New 1962 buyer's guide details process equipment available from Pfaudler Permutit Inc. Pfaudler Div. offerings include products fabricated from Glasteel, Nucerite, stainless steel, titanium, zirconium, tantalum and other materials for corrosion resistant services such as reactions, distillation and evaporation, drying and blending, centrifuging, heat transfer, filling, stor-



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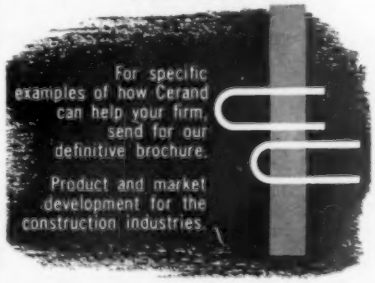
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THERMAL utilizes unique principles of design to provide refineries, chemical processors, metallurgical plants, and other industrial users with a source of inert or purge gases that is compact in size and provides high outputs for low initial cost. Standard outputs range from 2,000 scfh to 60,000 scfh.

A 30,000 scfh Gas Fired Generator Ready for Use

SUBMERGED EXHAUST OF COMBUSTION PRODUCTS makes feasible the use of low-cost or contaminated water as coolant without concern over fouling of surfaces. The tank of water through which the gases pass provides an unusual degree of safety. Heat transfer efficiency is extremely high.

REFRACTORY IS ELIMINATED and maintenance costs reduced through the use of the high heat release THERMAL burner which can be fired with gas, distillate oil, or dual fuel. Units are supplied as a complete package and include all control and safety equipment.

For detailed information write for Bulletin #114-B

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age, agitation, valving and piping. Permutit Div. products include equipment for water treatment, ion exchange, gas analysis, aeration, flow rate metering and control, demineralization and waste treatment. *Pfaudler Permutit Inc.*
Circle number (129) on reply card

Pseudocumene Now Commercial

Pseudocumene (1,2,4-trimethylbenzene) is now available in commercial bulk quantities from Enjay Chemical Co. at a spot price of 11 cents per lb f.o.b. Baytown, Tex. End use applications include trimellitic anhydride, methyl dicarboxylic acids and dimethylcarboxylic acids. Commercial specifications include 95% minimum purity with 98% minimum total aromatic content. Typical inspections are: boiling range, 335 to 340 F; water-white color; flash of 123 F. *Enjay Chemical Co.*
Circle number (130) on reply card

RW-330 Control Computer

Flexibility and high performance are featured in new RW-330 industrial control computer. Memory capacity can be supplied in a range from 4000 to over 100,000 words. Special commands, applicable to a particular control problem, can be added to the computer's already powerful command structure. The basic command structure, a unique organization of working registers and a 28-bit word length contribute to the machine's high performance. Additional instructions are performed in 260 microseconds, including minimum access time. Typical programs run at 600 to 1200 operations per sec. *TRW Computers Co., Div. of Thompson Ramo Wooldridge Inc.*
Circle number (131) on reply card

Removable Bundle Exchangers

New product bulletin describes standardized line of removable tube bundle heat exchangers having an externally packed floating head of improved design. Double O-ring seal protection is standard on Type OP units with shell diameters from 6 through 16 in. Sizes, dimensions and other specifications are given for these and also for larger Type SP models with shell diameters from 18 through 32 in. *Basco, Inc.*
Circle number (132) on reply card

Report on Hydrocarbons

Newly available report "Physical Constants of Hydrocarbons C_1 to C_{10}" presents in convenient form selected values of physical and thermodynamic properties of pure hydrocarbons. Authors are Clara E.

Miller, Carnegie Institute of Technology, and Frederick D. Rossini, University of Notre Dame. $1. *American Petroleum Institute.*
Circle number (133) on reply card

Rotameter Transmitters

Solid-state electric instruments can measure and transmit flow rates up to 200 gpm in lines up to 3 in. at pressures to 600 psig. Choice of five d-c output signals. Metal housing is directly coupled to SK Safeguard or metal tube rotameters. *Schutte and Koerting Co.*
Circle number (134) on reply card

Sophisticated Pipe Jacket

Extra long-life protection to pipe insulation is provided by a new laminated facing material consisting of aluminum foil, glass reinforcing strands and Tedlar, Du Pont's new polyvinyl fluoride film. Bonding these together is Pyro-Kure, American Sisalkraft's self-extinguishing adhesive. Tedlar film, the outer surface, is resistant to flexural failure, has excellent weatherability and is dimensionally stable at elevated temperatures. It remains flexible at 355 F and is resistant to flexural fatigue at 0 deg F. Pyro-Kure adhesive, a non-asphaltic product, gasifies when combustion temperatures are present and becomes self-extinguishing. *American Sisalkraft Co., Div. of St. Regis Paper Co.*
Circle number (135) on reply card

Specification Bronzes

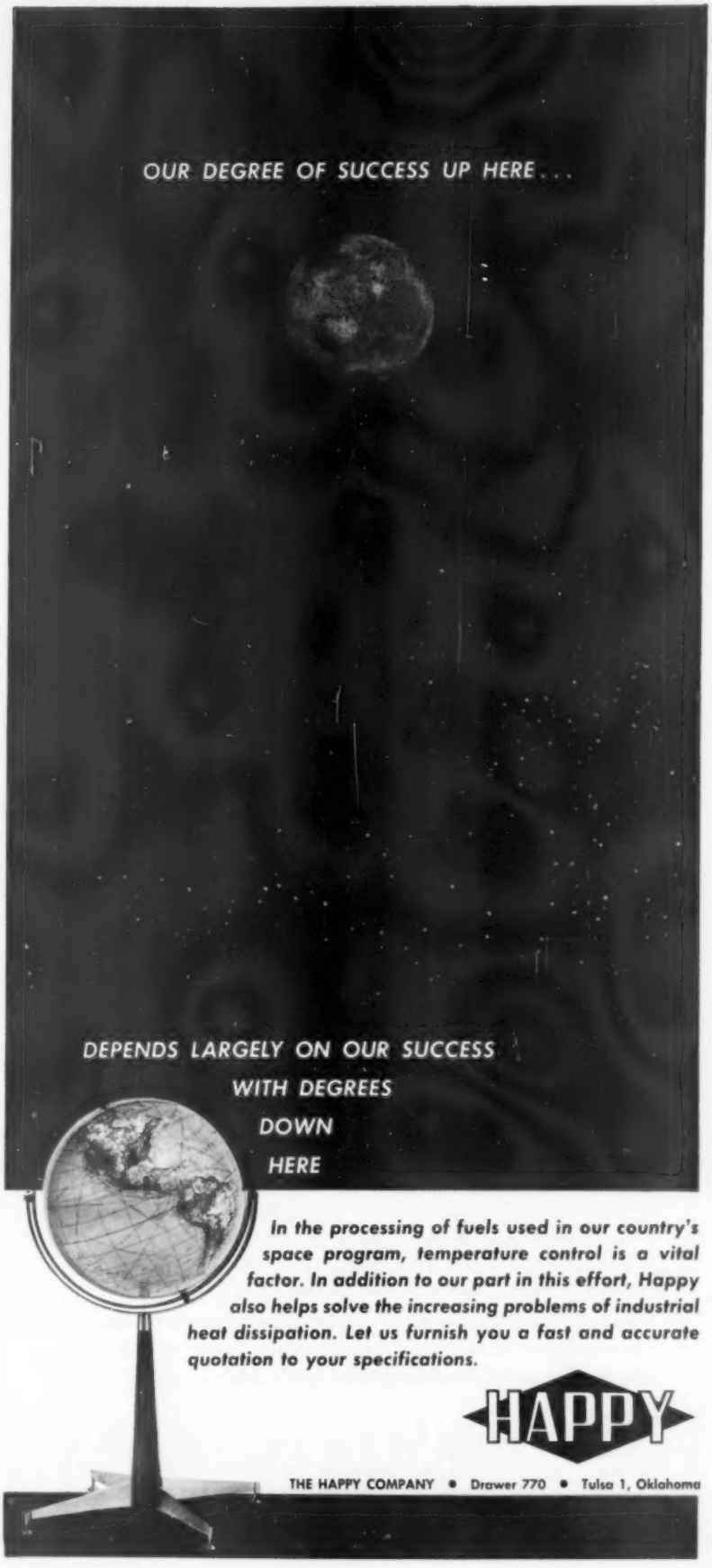
Forty-two specification bronzes plus heat treated variations are included in product data bulletin, G-61. It lists nominal chemical and average physical properties, available forms, government and society specifications the alloys meet and some typical applications. *Ampco Metal, Inc.*
Circle number (136) on reply card

Support for Liquid Loaders

New boom support units allow a 6-ft. longer radius for OPW long range (Type B) loaders to operate in. Boom units are fabricated of Schedule 40 steel pipe and come ready for mounting on risers. They have standard 150-psi welding neck flanges on inlet and outlet which mate with 125-psi cast iron flanges. *OPW Div., Dover Corp.*
Circle number (137) on reply card

Synchronous Motor Data

Low speed engine-type synchronous motors in the 20 to 10,000 hp and 72 to 450 rpm ranges are discussed in Booklet 502. Application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In the processing of fuels used in our country's space program, temperature control is a vital factor. In addition to our part in this effort, Happy also helps solve the increasing problems of industrial heat dissipation. Let us furnish you a fast and accurate quotation to your specifications.
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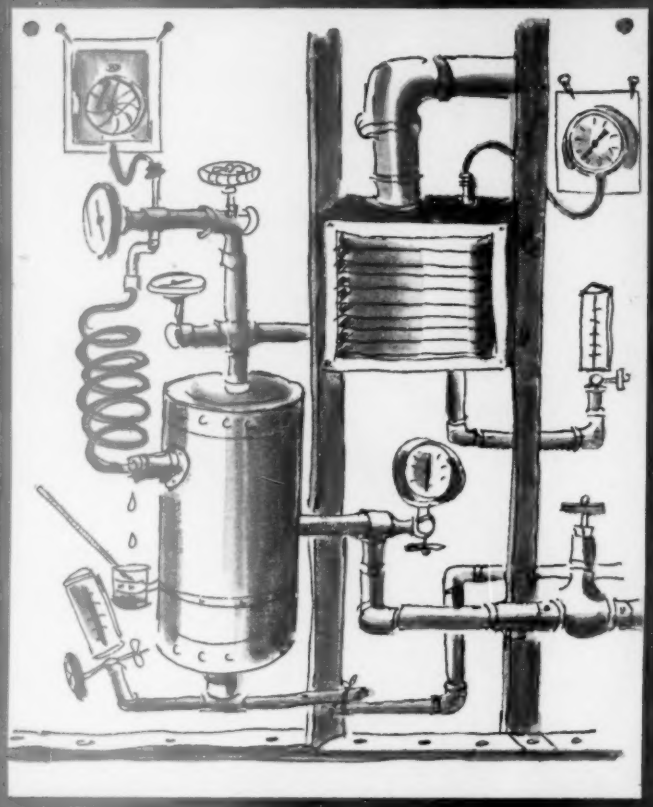

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Why the confidence? We have manufactured literally *MILLIONS* of different types of instruments for measuring and recording temperature, pressure, humidity and time-of-operation. More than likely, the special you're looking for has been produced by *Weksler*. At worst, your problem will prove routine for our engineers.

Save hours, money and a lot of headaches by consulting us *first*. Other manufacturer's *"Specials"* are probably *Standard* with Weksler.

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WEKSLER INSTRUMENTS

"ORIGINATORS OF WORLD RENOWNED ADJUST-ANGLE THERMOMETERS"

WEKSLER INSTRUMENTS
CORPORATION
195 EAST MERRICK ROAD, FREEPORT, L. I., N. Y.
Indicating, Recording, and Controlling Instruments for Temperature, Pressure and Humidity

data chart gives typical torque requirements for a variety of fields. *Ideal Electric and Manufacturing Co.*

Circle number (138) on reply card

Tank Cleaning Nozzle

Whirling nozzle No. 2445 for general tank cleaning applications has three flat spray orifices arranged to provide overlapping, hard hitting patterns with complete coverage over a 270-degree area inside the tank. Operating pressures are from 10 to 50 psig. Nozzle is of all stainless construction, smoothly finished for optimum sanitation. *Spray Engineering Corp.*

Circle number (139) on reply card

3½-in. Panel Instruments

New 3½-in. instruments broaden the Weston 1900 Series of rectangular a-c and d-c meters which previously included 4½, 5½ and 7½-in. sizes. Model 1931 instruments are available as ammeters, milliammeters, microammeters and volt meters, with choice of 1 or 2% accuracy. Instruments of 1% accuracy feature a knife-edge pointer and mirror scale; models of 2% accuracy are equipped with a lance-type pointer and conventional scale. Three types of mechanisms are available: unshielded external magnet types; shielded, core magnet moving coil types, and a-c iron-vane types. *Weston Instruments Div., Daystrom, Incorporated.*

Circle number (140) on reply card

Unique Check Valve Design

New check valves offer quick, quiet response and low pressure drop while providing protection from system surge and backflow. Can be mounted at any angle in a pipe compressor discharge line. Available in alloy steel, cast steel or cast iron bodies in sizes from 6 to 48 in. for pressures to 1000 psi. *Clark Bros. Co.*

Circle number (141) on reply card

Valve for 1000-deg Service

Graphitar seats in McCannaseal ball valves make possible their use at temperatures to 1000 F when handling nonoxidizing liquids or gases and to 700F for oxidizing reagents. At 1000F, bodies of 316SS with 300-lb ASA rating are suitable for pressures to 355 psig; carbon steel for pressures to 80 psig. The same materials in 150-lb ASA rating valves are suitable for pressures to 40 psig at 1000 F. Higher pressures are permissible at lower temperatures. Available with screwed and socket weld end con-

nections in 1-in. through 3-in. sizes, and with 150-lb or 300-lb ASA flanged ends in 1-in. through 8-in. sizes, either manually or pneumatically operated. *Hills-McCanna Co.*
Circle number (142) on reply card

Sweetening With Tenamene 2

Inhibitor sweetening of gasoline stocks with Tenamene 2, a phenylene-diamine-type antioxidant, is discussed in 16-page Bulletin I-111. *Eastman Chemical Products, Inc.*
Circle number (143) on reply card

Controlled Feeding for HPI

Feeding, weighing, blending and proportioning equipment for the controlled feeding of liquids and solids in process industries is detailed in Bulletin 4.40-1. Contains descriptive material, photographs and schematics of typical process systems. *B-I-F Industries.*
Circle number (144) on reply card

Con-O-Sphere Ball Valve

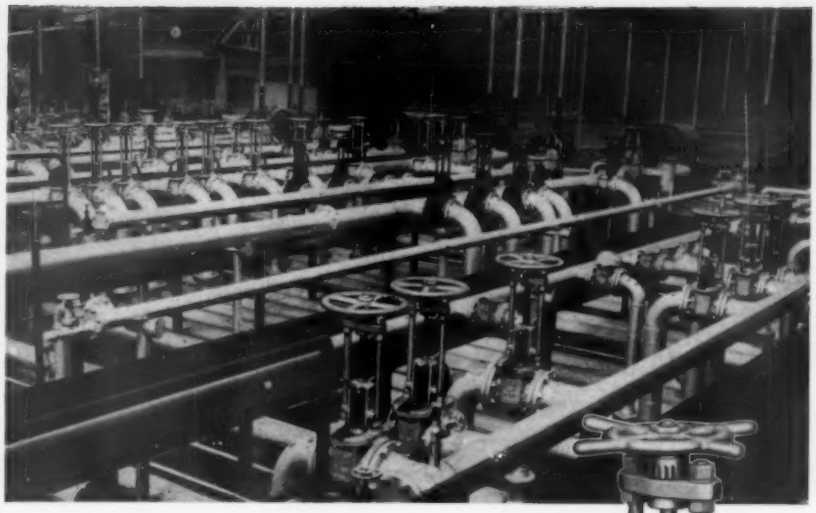
New Con-O-Sphere ball valve for the process industries features a sealing capsule of conical-shaped Teflon which is molded around the ball that controls the on-off action of the valve. The ball, its handle stem and its sealing surfaces are molded as one unit in this valve, which also boasts a screw-in base plate. Removal of the base plate allows the sealing capsule to drop out; insertion of a new capsule is said to completely overhaul the valve in three minutes. *W-K-M Div., ACF Industries, Inc.*
Circle number (145) on reply card

Coupling Selector Guide

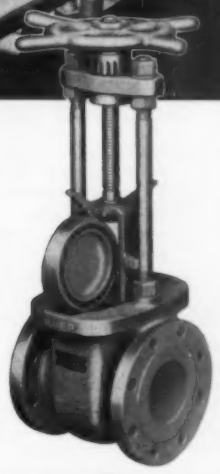
Simplified selection of quick connect/disconnect couplings is assured with comprehensive 62-page catalog that features a packer usage guide. Listing more than 575 fluids and gases, the text points out the different types of seals to be used with these fluids at various temperature limits. *Snap-Tite, Inc.*
Circle number (146) on reply card

Instrumentation Systems

Various measurement instruments and complete instrumentation systems for flow, level, pressure, temperature and other process variables are detailed in new condensed Catalog 310, "Instrumentation for Process Measurement and Control." F&P standard size and miniature indicators, transmitters, recorders and controllers, as well as pertinent sensing elements, are also listed and described. *Fischer & Porter Co.*
Circle number (147) on reply card



SAVE 90% AND MORE
ON LINE BLINDING COSTS
with
HAMER LINE BLIND VALVES

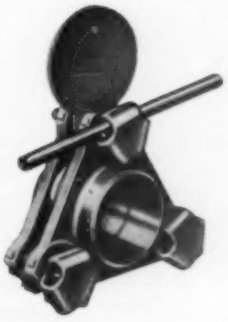


VISIBLE WEDGE LINE BLIND VALVE
No line movement necessary to operate. No spillage or loss of product.

It takes one man just a few minutes to open and close a Hamer Line Blind Valve. Compare this with the old fashioned method of inserting and removing a "skillet" blind between multi-bolt flanges. Cost records from scores of users show Hamer Line Blind Valves save 90% and more every time a line is blinded. Multiply these savings by the number of lines and times they have to be blinded and you can quickly see why Hamer Line Blind Valves pay out fast.

Furthermore there is no product loss with most models of Hamer Line Blind Valves. Simplicity, positive visible shut-off, no contamination and safety are added benefits of Hamer Line Blind Valves.

Hamer valves are applicable wherever lines require blinding. They are available in special alloys and with special trim for severe conditions. Write for Hamer Catalog 60 for complete description of all types, sizes and pressure ratings.



3-BOLT LINE BLIND VALVE
Particularly suited for installations where slight spillage and line spreading are no problems.

WECO®
WELL EQUIPMENT MFG. CORP.
P. O. BOX 19465 • HOUSTON 24, TEXAS
Division of CHIKSAN COMPANY
a subsidiary of FMC CORPORATION
fmc CORPORATION

Inspect Gas Lines by TV

The first mass-produced television system for inspection of gas lines is now being marketed by Inspectoline, Inc. The water tight system is complete with enclosed lighting system, 500 or 1100 ft of cable and a generator. Can be pulled through gas mains as small as 4 in. in diam and as large as 48 in. in diam. *Inspectoline, Inc.*
Circle number (148) on reply card

Meter Catalog Offered

New 28-page catalog P&I-2000 describes Rockwell's complete line of petroleum and industrial meters and accessories. *Rockwell Manufacturing Co.*
Circle number (149) on reply card

ARKANSAS LOCATION

3 — Worthington 3500 CFM air compressors, 24 x 15, Model #LTC-4, 500 HP gas engine drive.

1 — Chicago-Pneumatic 3060 CFM air comp., 60 PSI, #19-32-30-18x24, steam driven.

20 — 28,000 gal. horiz. steel tanks, 11' x 38' ASME 75 PSI WP.

20 — Large steel API heat exchangers.

PERRY EQUIPMENT CORP.
1428 N. 6th St. Phila. 22, Pa.
POplar 3-3505

108 Chemicals Cataloged

Hooker's 108 organic chemicals for industry and agriculture are described in the company's latest catalog. Ranging from alkali to zinc phosphide, the list of chemicals covered also includes market development and other development chemicals as well as products of the phosphorus division. *Hooker Chemical Corp.*
Circle number (150) on reply card

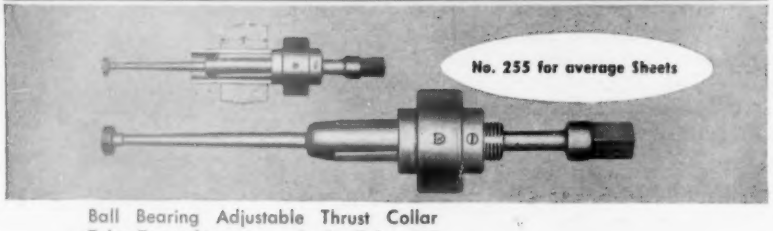
Scale Model Materials

Plastic piping and other components for building scale models are listed and illustrated in new looseleaf supply catalog. *Engineering Model Associates, Inc.*
Circle number (151) on reply card

Technical Data on Ethylene

New 20-page booklet covers all major chemical reactions of the ethylene molecule and gives extensive bibliographical references for further investigation of reactions involving ethylene's double bond. Physical properties are given in both tabular and graphic forms for maximum reader convenience. *U. S. Industrial Chemicals Co.*
Circle number (152) on reply card

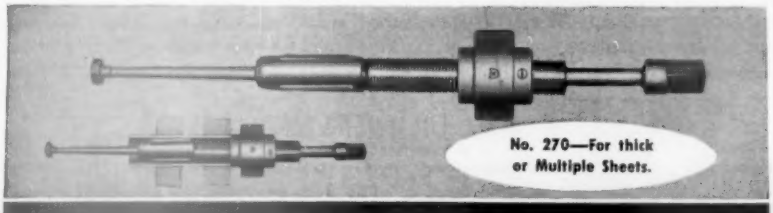
WIEDEKE Precision-Built Tube Expanders



Ball Bearing Adjustable Thrust Collar Tube Expanders are made for Tubes ¼" diameter and larger.
Recommended for use with any Controlled Rolling Motor for uniform expansion of Tubes.

See your Dealer or write us for Bulletin.

For Rolling—Heat Exchanger, Condenser and other Heat-Transfer Tubes.



THE GUSTAV **WIEDEKE** COMPANY
DAYTON 1, OHIO

Choosing an Antioxidant?

DALPAC® 4

SAVES YOU MORE

Refinery customers have found that, in comparison with other inhibitors, Dalpac 4 (Hercules 2,6-di-tert-butyl-p-cresol) saves up to three dollars on every thousand barrels of gasoline produced. Dalpac 4 inhibits gum formation, stabilizes gasoline color, and helps maintain engine cleanliness. Refiners have also found it to be excellent in turbine and transformer oils where it prevents deterioration, and does not affect electrical properties.

For additional information write:

Oxychemicals Division
Naval Stores Department
HERCULES POWDER COMPANY
900 Market Street
Wilmington 99, Delaware

NOS9-5R

Through complete Quality Control—Nicolet Asbestos Pipe Line Felts have received universal acceptance for their uniformity and absolute dependability. ■ Whether your pipe line requirements demand Nicolet Asbestos #15 "Standard", #8 "Tufbestos" or #10 "Reflecto" (the new, improved, white Asbestos Felt) you are assured of getting the best protection obtainable. ■ And now—the addition of "Old Nic" Glass Wrap to this family of Pipe Wrap products makes Nicolet your best source for complete pipe line protection. ■ "Old Nic" Glass Wrap has uniform porosity which allows hot tar or asphalt enamel to bleed through, while letting hot gas escape, minimizing "holidays". "Old Nic" Glass Wrap will most effectively protect yard wrapped pipe against impact damage. It is equally effective in over-the-ditch operations. ■ **Write today for full specifications and samples of Nicolet pipe protection products.**

Distributed throughout the United States

NICOLET INDUSTRIES, INC.

FLORHAM PARK, NEW JERSEY

You've proved the Roots 3M125 for dependability, easy installation and accuracy...

now try this one for SIZE!

A 7000 cfh* line-mounted Rootsmeter less than 18″ long

Now you can have the advantages of both rotary-positive-displacement metering and line-mounting in a 7000 cfh Rootsmeter, Model 7M125, as well as in the already widely accepted 3000 cfh model.

Rootsmeters are accurate through wide ranges of pressure and flow—unaffected by fluctuations. And because of Roots proved operating principle, you can be sure the accuracy is permanent.

The new meters are designed for easy line-mounting. The 7000 cfh model is less than 18″ long, and the 3000 cfh model is only 14″ long. Connections are flanged to ASA C.I. standards, and line-mounting Rootsmeters require no special supports for simple horizontal or vertical installation.

There are a lot of other advantages in these Line-Mounted Gas Meters, too. You can easily read total flow through the convenient protective lens of the direct-reading volume register, yet the register itself is enclosed entirely within the meter case, eliminating problems incurred with external counters. And if you wish, the meter can be easily instrumented. Maintenance is simple: just replenish the oil occasionally; convenient bulls-eye oil-level gauges make checking easy. There are no internal valves, orifices, or diaphragms to wear or be damaged, and no stuffing boxes to maintain. Testing is easy too, with simple connections provided for standard proving procedures.

Whether your problems are in gas production, transmission, or distribution, or if you meter industrial or institutional gas, you'll find Line-Mounted Rootsmeters the most accurate and dependable, easiest to install, and most convenient gas meters you've ever used. Call your Roots-Connersville engineer or write for details of all the advantages of new Line-Mounted Rootsmeters.

*Dial Rate

ROOTS — DRESSER INDUSTRIES INC. — OIL · GAS · CHEMICAL ELECTRONIC · INDUSTRIAL

ROOTS-CONNERSVILLE BLOWER DIVISION
900 W. MOUNT STREET, CONNERSVILLE, INDIANA
In Canada—Roots-Connersville Blower (Canada) Ltd., 629 Adelaide Street, West, Toronto

For Further Information on Advertised Products See Reader Service Card

Shaping the Future

EXCLUSIVE "KEY CLUB"

An exclusive "key club" has been formed by the El Paso Natural Gas Products Company at its newly completed Phoenix products terminal. Membership is restricted to the company's trucker members. Each customer is issued a key card, which is inserted in a meter controlling the product he wants. This is the beginning of a series of activities that enables the trucker to receive his product, obtain a loading ticket imprinted with gallonage, and have his purchase recorded automatically by typewriter and punch tape for terminal and headquarter records.

TV A MEETING AID

Television is bringing about a change in the traditional pattern of technical and scientific meetings. Says Nelson Hibshman, executive secretary of AIEE: "Today, in addition to listening to the presentation of a technical paper, the individual wants to see its application and the tool, machine or process making the application of its basic idea possible." Such visual demonstration will be made an integral part of the technical sessions at the AIEE Winter General Meeting in New York, he says.

REVISED STANDARD

Second edition of API Standard 2501 "Crude Oil Tank Measurement and Calibration" has been published. The standard contains information on calibrating wooden, vertical steel and stationary horizontal cylindrical tanks. There are also sections on calculation methods for incremental and total tank capacities of both vertical and horizontal cylindrical tanks, as well as information on liquid calibration and gage tables.

LONGEST NITROGEN LINE

Longest nitrogen pipeline in the U.S. — 22 miles — will soon be a reality, says Air Reduction Company. The company will pipe more than 100 tons a day from its plant at Claymont, Delaware, through the system to chemical plants in New Jersey. It will be one of the eight lines being constructed by SunOlin Chemical Company to carry various raw materials to chemical plants.

BECHTEL'S NEW 777 DITCHER HIGHBALLS MIDDLE WEST LINES AT 10,000-FT. IN 12 HOURS

Up to 1000′ per hour recorded on 54″ x 7′ ditch while sloping up to 9′ wide; 8½′ digging depth eliminated 40% of backhoe work on hillsides and road crossings.

The new Barber-Greene Model 777 is setting production records wherever it is working. Field reports show 10,000-ft. of 54″ x 7′ trench in a 12-hour day. Pipeline crews have enthusiastically welcomed the 777's 8½′ digging depth and the resulting sharp reduction in backhoe work on hills and at crossings.

This new Barber-Greene pipeline ditcher digs up to 40% faster, weighs 37% more, has 40% more power and digs one foot deeper, than any other full-crawler pipeline wheel ditcher. Exclusive Hydra-Crowd transmission lets operator dial the precise speed to match ground conditions – keeps maximum machine power applied to the job at all times.

Standout specifications: 135 hp diesel power; digs 8′6″ deep and 54″ wide trench (to more than 10′ at trench top with slopers); weighs 57000#; exclusive dual-range Hydra-Crowd puts infinite number of crowding speeds from zero to 66 fpm at operator's fingertips; hydraulically driven spoil conveyor, crowding, transmission wheel speeds and wheel hoist are completely independent of each other; belt speeds infinitely variable to 1,000 fpm; three-point suspension; flexible drawbar; and digging wheel mechanically driven by short drive chains and split drive shaft.

Write for new 777 Bulletin, specifications and comparisons.

LOWBOY PORTABLE—The Model 777 is the only wheel ditcher of its digging range that can be transported by lowboy trailer with no disassembly. Unloads ready to dig ditch.

Barber-Greene Ditcher Line A Complete Pipeliner's Package

MODEL 774 with 5½′ wheel cuts from 18-30″ wide. Can be equipped with 7′ wheel for 50% less than any other wheel ditcher with this depth capacity.

MODEL 773 trenches 10-24″ wide and to 5½′ depths. Model 772 identical except for narrower track gauge and pad widths. Works within 19″ of side obstructions.

MODEL 784 heads Barber-Greene Vertical Boom Ditcher Line. Machines utilize same chassis as Model 774, cuts low cost trench from 18-24″ wide and to 7′ deep.

BECHTEL CORPORATION'S first assignment for their new Barber-Greene Model 777 was 102 miles of trenching, covering virtually every kind of terrain in the Midwest.

MODEL 705-B RUN-ABOUT is an all-ground, all-weather Vertical Boom Ditcher with 16 mph road speed to handle the scattered jobs most profitably. Hydra-Crowd transmission provides infinite number of crowding speeds from 0 to 16 rpm.

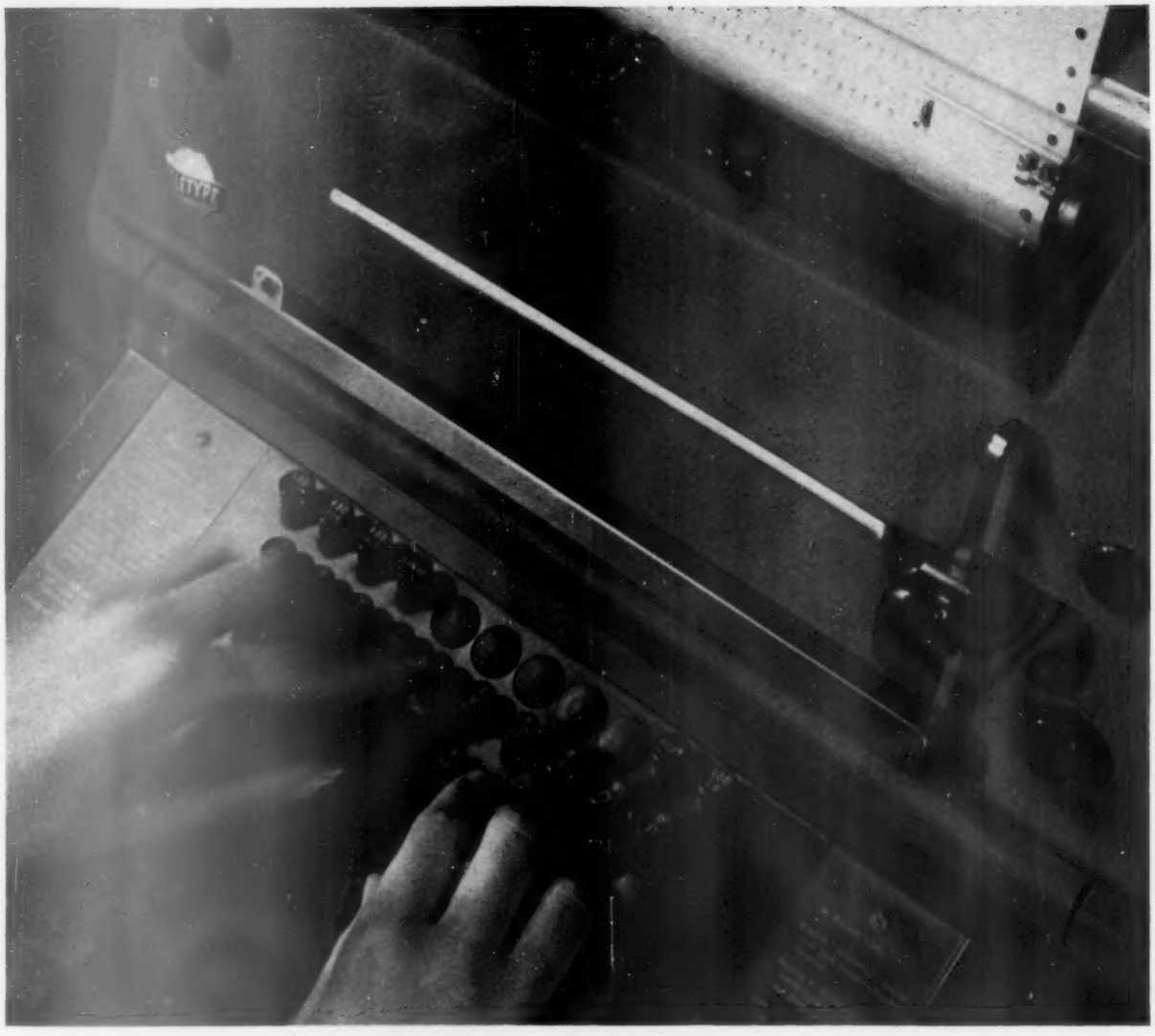
Manufacturer of the only modern ditcher line.

Representatives in Principal Cities of the World

Barber-Greene BG

Main Office and Plant AURORA, ILLINOIS, U. S. A.
Other Plants: DeKalb, Milwaukee, Detroit, Canada, England, Brazil, Australia

CONVEYORS • LOADERS • DITCHERS
ASPHALT PAVING EQUIPMENT



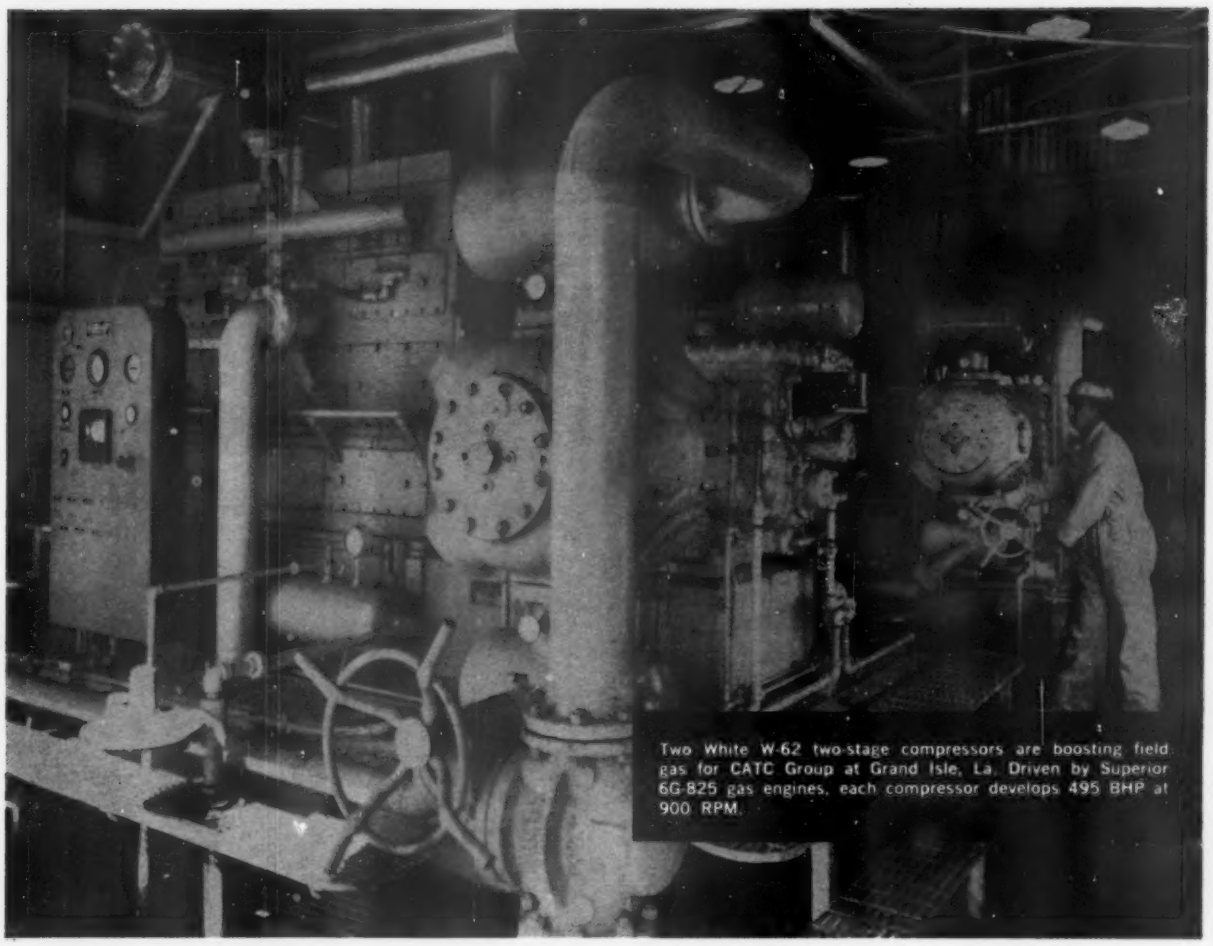
Communications versatility at your fingertips

With Teletype Model 28 printers your messages and data can be sent quickly and economically to any destination, near or far. But this is only part of the story—these printers offer an array of optional features that can multiply the usefulness and versatility of your communications system, save you important time and effort. Here are examples:

- Pin-feed platen for controlling multi-copy business forms.
- Choice of platen widths to accommodate almost any size form or message paper.
- Vertical as well as horizontal tabulators.
- Automatic form feed-out—spaces out completed form with one key stroke, brings next form to starting position.
- Variety of type styles and sizes.
- Parallel-wire arrangement for business machine print-out.
- Built-in sequence selector for controlling remote equipment.
- Adaptable for DATA-PHONE and telegraphic communications services.

Teletype equipment is manufactured for the Bell System and others who require the utmost reliability from their data communications systems. For further information write to Teletype Corporation, Dept 47K, 5555 Touhy Ave., Skokie, Illinois.

TELETYPE®
CORPORATION • SUBSIDIARY OF *Western Electric Company* INC.



Two White W-62 two-stage compressors are boosting field gas for CATC Group at Grand Isle, La. Driven by Superior 6G-825 gas engines, each compressor develops 495 BHP at 900 RPM.

ONSHORE-OFFSHORE... CATC* Served

By White/Superior Engine-Compressor Sets

Two White/Superior engine-compressors on field gas booster service for CATC Group (Continental Oil Co., Operator) will be followed by two additional units, offshore. The recent order specifies two W-64 three-stage compressors driven by Superior 8G-825 gas engines, each developing 660 BHP at 900 RPM. Job site is CATC's Block 30 offshore platform, West Delta field, off Grand Isle, La. White's is the only *matched-design*, balanced-opposed unit available in the 660 HP category. It's specially suited to offshore service because there are no horizontal primary unbalanced forces to shake the platform and disturb auxiliary equipment and instrumentation.

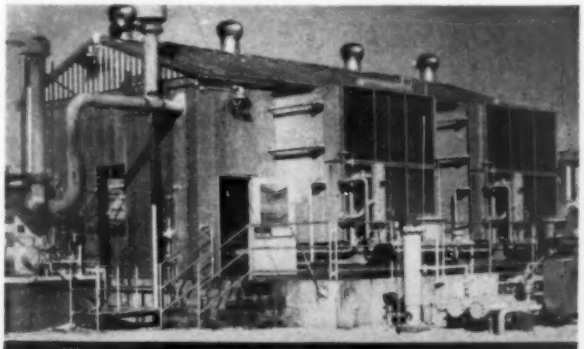
White's medium speed, heavy duty compressors—two, four and six-cylinder models, 200 to 1000 BHP—offer cylinder sizes from 4000 PSI, 2⅝" dia. to 85 PSI, 22½" dia., providing 68 standard cylinders. Custom sizes and designs are also available. Write for new Bulletin 124, describing compact packages for gas lifting, boosting, repressuring, peak shaving, underground storage applications, etc. White Diesel Engine Division, Springfield, Ohio.

**Continental Oil Company, Atlantic Refining Company, Tidewater Oil Company, Cities Service Oil Company*

White DIESEL | Superior ENGINES

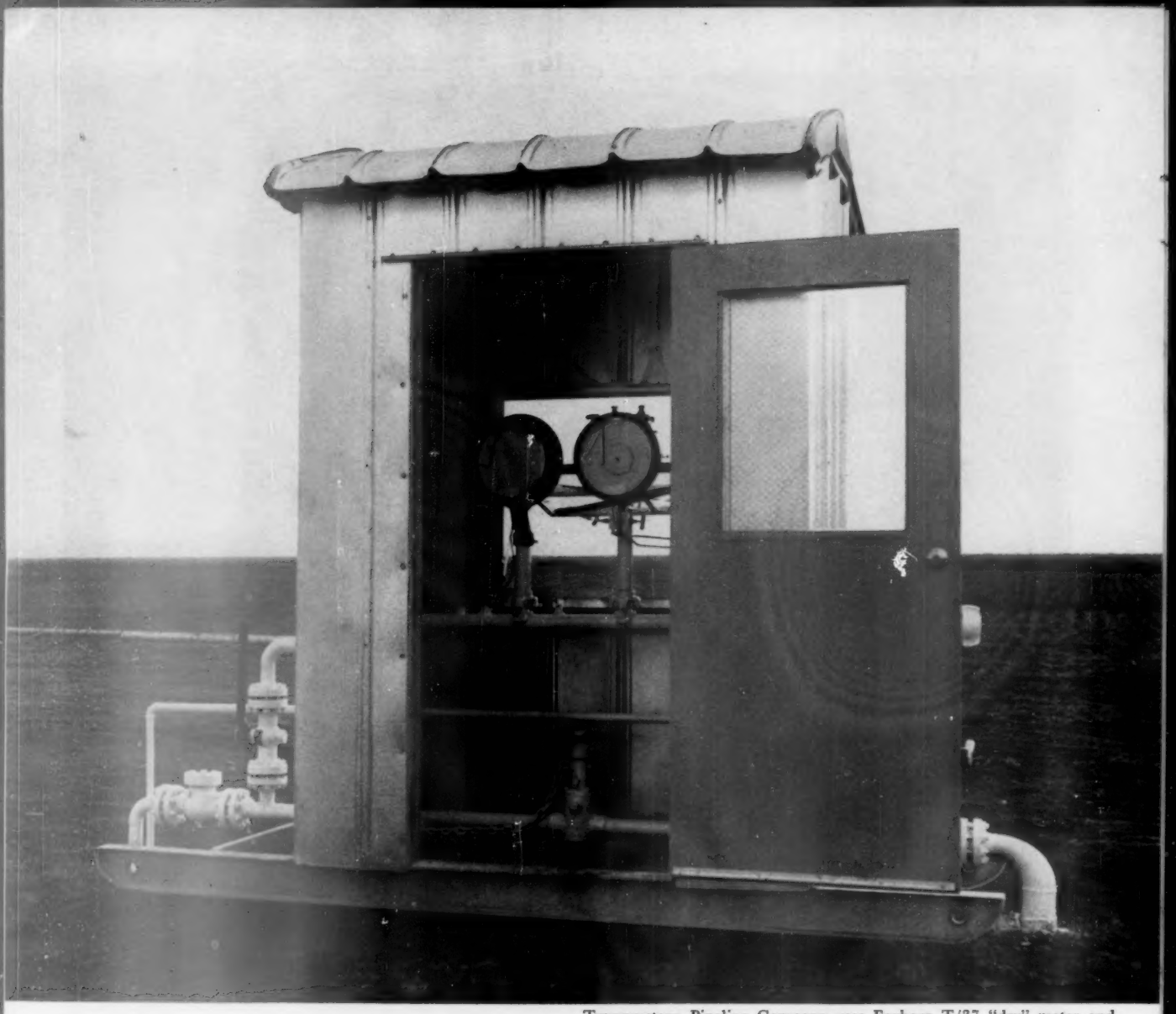
White Diesel

ENGINES / COMPRESSORS



Engine exhaust gas is used for regeneration purposes on glycol dehydration unit.

For Further Information on Advertised Products See Reader Service Card



Transwestern Pipeline Company uses Foxboro T/37 "dry" meter and temperature recorder to log gas purchased from Parsell Field, Texas, well.

wet gas, line surges, the weather... nothing upsets Foxboro "dry" flow meters

All Foxboro T/37 Meters have specially-formed diaphragm discs with solid metal spacer rings. Diaphragm assembly can't be damaged by overrange, line surges, or winter freeze-ups.

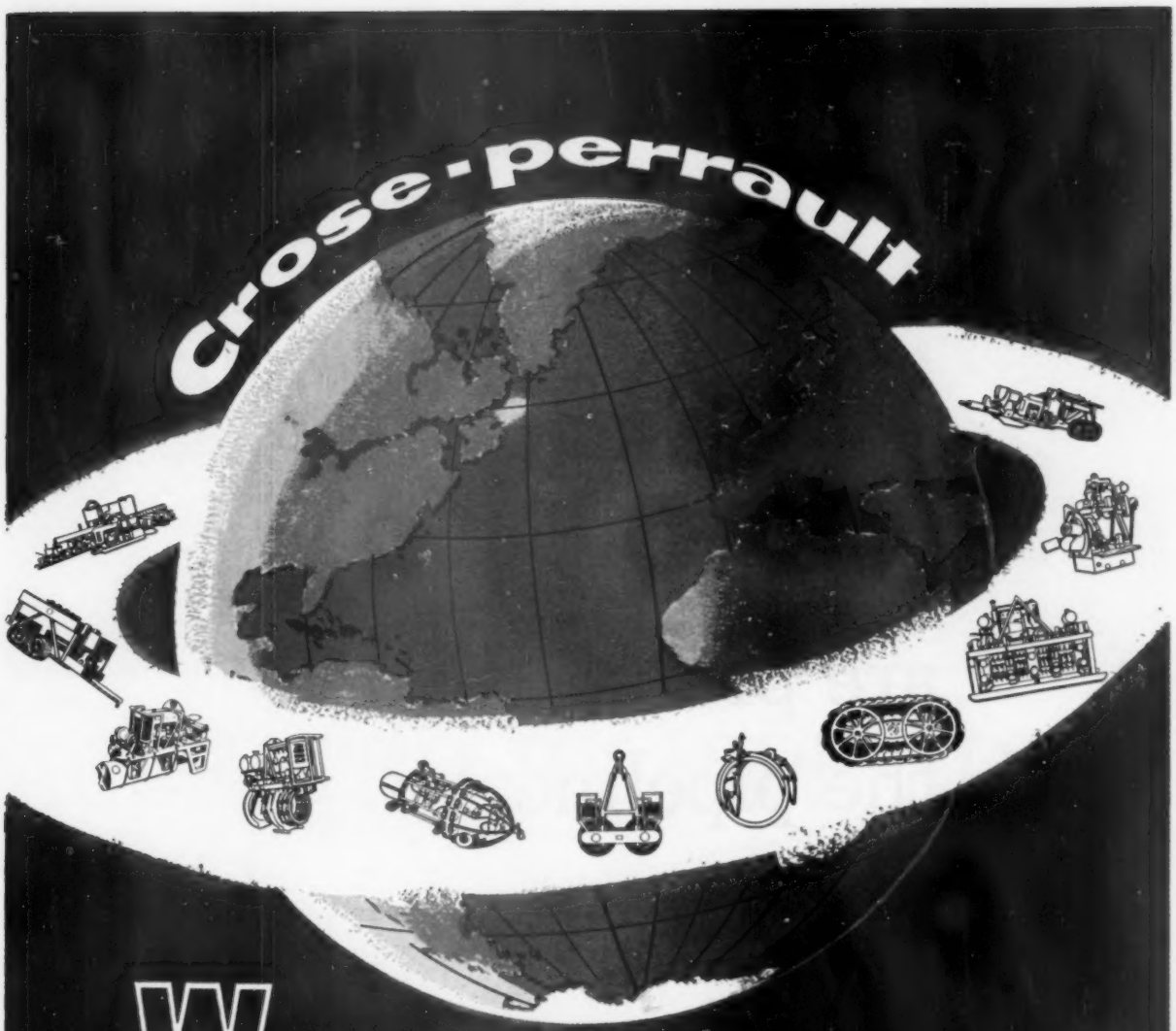
You'll find Foxboro T/37 Flow Meters on gas wells and gathering lines all over the Texas Panhandle... including many of those owned by Transwestern Pipeline Company—America's newest supplier of natural gas.

Since Panhandle gas normally contains a high amount of liquid hydrocarbons, the T/37 is a "natural." There is no mercury to clean or replace. Maintenance is kept to a minimum. In addition the T/37 is completely free from zero drift and ambient temperature effects . . . resulting in the highest sustained accuracy of gas flow measurement.

No wonder both pipeliners and producers are high in their praise for the Foxboro T/37. Mercury-less—accurate—almost indestructible, it's the flow meter that's setting new standards for gas measurement. Ask your Foxboro Field Engineer for complete details. Or write for Bulletin 7-15. The Foxboro Company, 381 Norfolk St., Foxboro, Massachusetts.

FOXBORO

REG. U. S. PAT. OFF.



WORLDWIDE LEADER

PIPELINE EQUIPMENT, MATERIALS AND SUPPLIES

Crose-Perrault is the largest supplier of pipeline equipment in the world. Thousands of miles of pipeline experience with pipeline contractors throughout the world have earned Crose-Perrault this world wide leadership because of proven equipment, engineered and designed to deliver long term performance under the toughest conditions with maximum efficiency. Crose-Perrault is proud of its reputation as the most complete pipeline equipment source in the world.

Crose perrault

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ONE TELEPHONE CALL TO CROSE-PERRAULT IS ALL THAT'S NECESSARY.

Everything you need in pipelining from heavy equipment to miscellaneous supplies can be obtained by contacting Crose-Perrault.

REMEMBER
WEbster 6-2171

Here's why line walkers seldom spot trouble when J-M wraps are protecting the pipeline:

Year after year, the trouble-free *complete* pipeline protection provided by J-M Transhield and J-M Blue Flag has built up an impressive record of performance.

Year after year, these two materials have *proved* their efficiency.

Rather than merely making claims, we have chosen to stand on this performance record.

J-M BLUE FLAG® is a porous fiber glass mat which gives coatings extra strength and working life. It reinforces the enamels so they are better able to resist cracking, breaking, chipping or flaking . . . both during installation and after the pipe is in the ground.

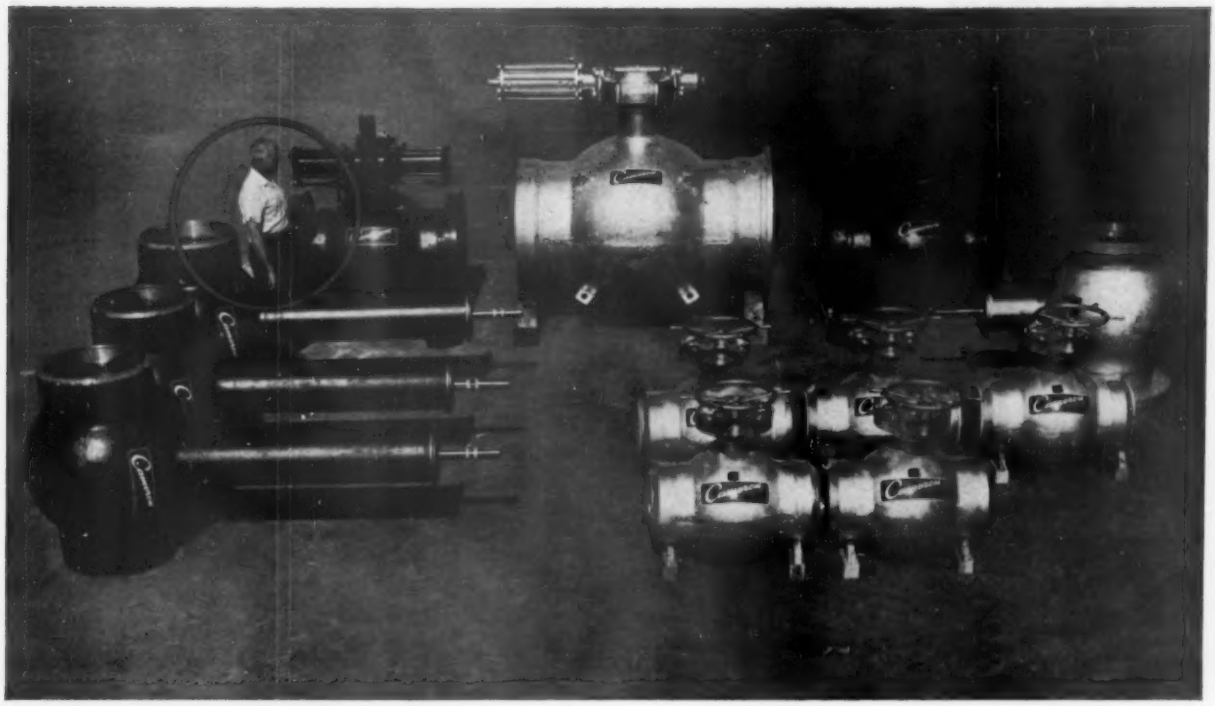
J-M TRANSHIELD® is an asbestos felt which provides a tough, durable outer shell. Because it is made with asbestos, Transhield forms a stone-like barrier against forces attacking the pipeline. Transhield is available impregnated with either coal tar pitch or asphalt.

Be your own "comparison shopper." Look at any other protective materials in the market. Talk to people who have used them, as J-M's sales and research men do all the time. Compare performance and maintenance costs. Your findings will convince you that J-M Transhield and J-M Blue Flag offer you more protection than any other pipe wrap materials. Specify them—for protection that never takes a holiday.

For more information, write to Johns-Manville, Box 158, Dept. PE 1061, New York 16, N. Y. In Canada, address Port Credit, Ont. Offices throughout the world. Cable: Johnmanvil.

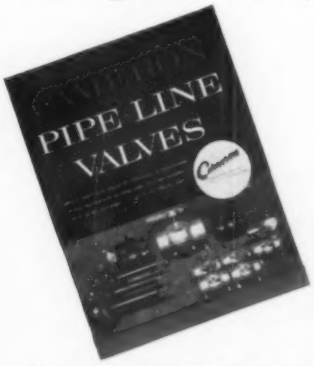
JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS



ACCEPTED BY PIPE LINES

Cameron Ball Valves are winning increasing acceptance by pipe line companies the world over. The companies like the compact design, the simplicity and the light weight in comparison with conventional valves. Cameron Ball Valves are easier to handle and easier to coat than conventional valves. There are no bonnets or glands to leak, and no lubrication is required either for sealing or to reduce friction in operating the valve. Torque required to operate the valve is amazingly low because the pressure of fluid against the ball is carried by low friction Teflon bearings, and the seat ring area in contact with the ball is small. A tight shutoff for countless operations is insured by the rotating seat design.



Ask a Cameron representative or write for a pipe line valve catalog.

Cameron

CAMERON IRON WORKS, INC.
P. O. BOX 1212 • HOUSTON, TEXAS

CAMERON BALL VALVES

CONTROL . . . essential element in economy!

In any engineering or construction project the real basis of economy is fast completion. Brown & Root has become legend for putting plants "on the line" ahead of schedule. ▲ This is possible because, with its own personnel and equipment, Brown & Root has the capability of a "turnkey" job. Every step is carefully controlled, from engineering through the manifold steps of construction and equipment installation. This "control" can be interpreted in fast, economical completion for you. ▲ If your organization is planning new construction or plant expansion, you'll profit by talking to the man from Brown & Root.

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an ounce of prevention that really PAYS OFF...

UNICOR®

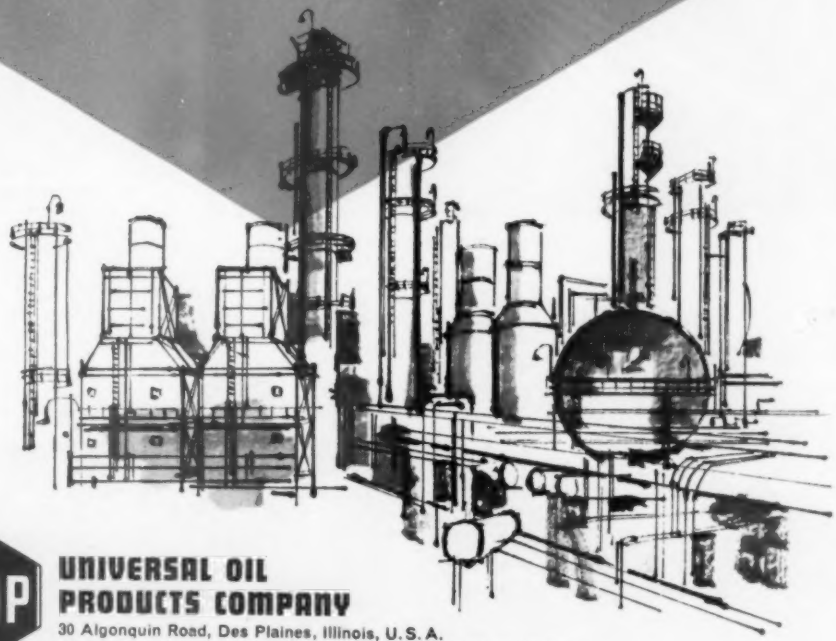
by protecting thousands of square feet of pipeline and refinery equipment

An ounce of prevention is worth a *ton* of cure . . . when it's an ounce of UNICOR.

Put 10 to 20 parts of this amazingly potent inhibitor in a million parts of crude or refined petroleum product . . . and see what happens: The UNICOR, an oil-soluble corrosion inhibitor, plates out on inner surfaces of pipeline and refinery vessels and tanks **. . . provides lasting protection against corrosion.**

Added at any point in your operation, UNICOR protects both metal and product, reduces downtime and cost of cleaning and maintenance, assures full flow capacity, keeps power costs at a minimum, safeguards product purity.

Write for information and samples. Address our Products Department.



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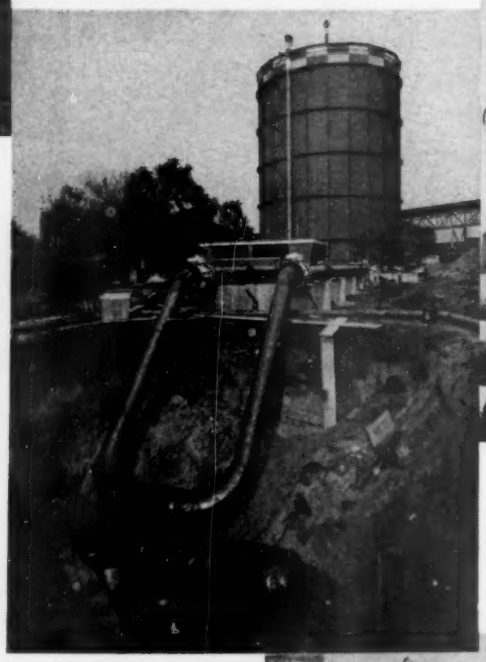
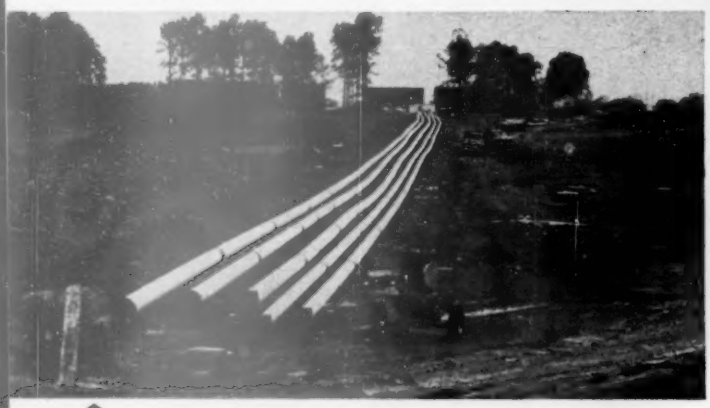
CABLE AND CABLE SPLICES in communications service are effectively and economically protected by TAPECOAT.



Lines in **OFF-SHORE DRILLING** operations need joint protection equivalent to the mill-wrapping on the pipe. TAPECOAT is most economical because it gives lasting protection in underwater service.



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UNDERGROUND GAS STORAGE facilities can be "buried and forgotten" when protected by TAPECOAT. Note protection of tanks, pipe and pipe joints.

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Lines buried in cinders in **RAILROAD YARDS** need the sure protection provided by TAPECOAT. There's a size for every purpose from 2" to 24" in width.

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Throughout the 1,018 miles of its 36" section, the new Alberta to California natural gas pipeline uses Grove Series G-4 mainline valves. These valves are among the largest full-opening mainline valves ever put in service. They feature the field proven patented Grove Seal-"O"-Ring® design, with its "double-barrier seal." A positive, primary metal-to-metal seal is backed up by the squeegee and sealing action of protected o-rings, to assure a bubble-tight seal, easy open and close. Because G-4 valves do not rely on sealing compounds, they completely eliminate all maintenance costs relative to lubrication. Call your nearest Grove office and learn how Grove pipeline valves can serve and save for you in your next pipeline.

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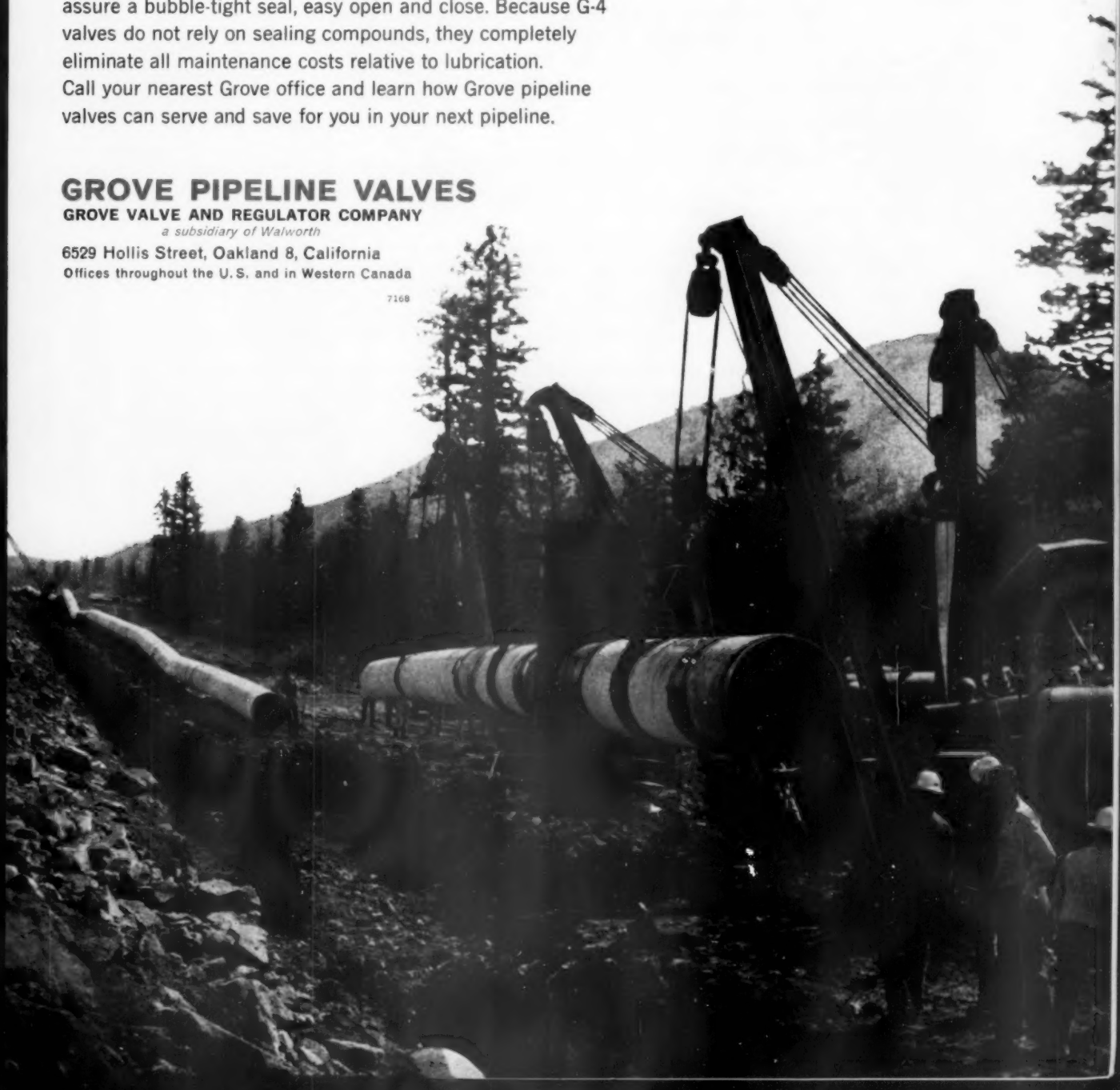

BIG, NEW, EXTRA-TOUGH DOZERS BOOST DIRT YARDAGE

Take full advantage of Allis-Chalmers tractor power with the new line of heavier, tougher, straight, U and semi-U blade dozers and angling-type dozers. Extra-heavy-duty cutting edges and end bits, extra moldboard height give you bigger loads, extra strength throughout.

Whatever the right-of-way—trees, brush, rock, swamp, hills, gulleys—Allis-Chalmers can offer you the right tractor-dozer combination to meet the condition . . . hydraulic or cable-controlled; full U blade, wide or narrow semi-U blade; straight blade; hydraulic tilt dozer; cable- and hydraulic-type angling dozers; plus interchangeable dirt points and rock points.

Each dozer is designed to take full advantage of the power, strength and balance built into the tractor to give you big production yardage. Dozers are built for greater strength, flexibility and bigger output with higher, stronger, more rigid moldboards; bigger, heavier cutting edges and end bits; forged steel, ball-type push-beam trunnions; and extra-tough custom-rolled, special alloy steel C frames and push-beams.

New long-life, triple-valve hydraulic system for the HD-21 gives you positive control of blade lifting, lowering and tilting, and ripper lifting and lowering.

Compare Allis-Chalmers tractors with any other on major features. Inspect Allis-Chalmers tractor undercarriage; the healthy fuel-miser engine; all-steel main frame; double-reduction final drives; the industry's toughest track, and many other cost-cutting features. Then get convincing proof with a demonstration from your Allis-Chalmers dealer. *Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.*

NEW F-100 FRONT-MOUNTED CABLE CONTROL UNIT

New cool-running, sure-acting cable control unit is the only fully sealed, fully anti-friction bearing unit in the industry. Brake drums, bands and planetary gears run in a bath of oil. It has already recorded new standards for exceptionally long life.

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Operator comfort
Wearability
Ease of maintenance
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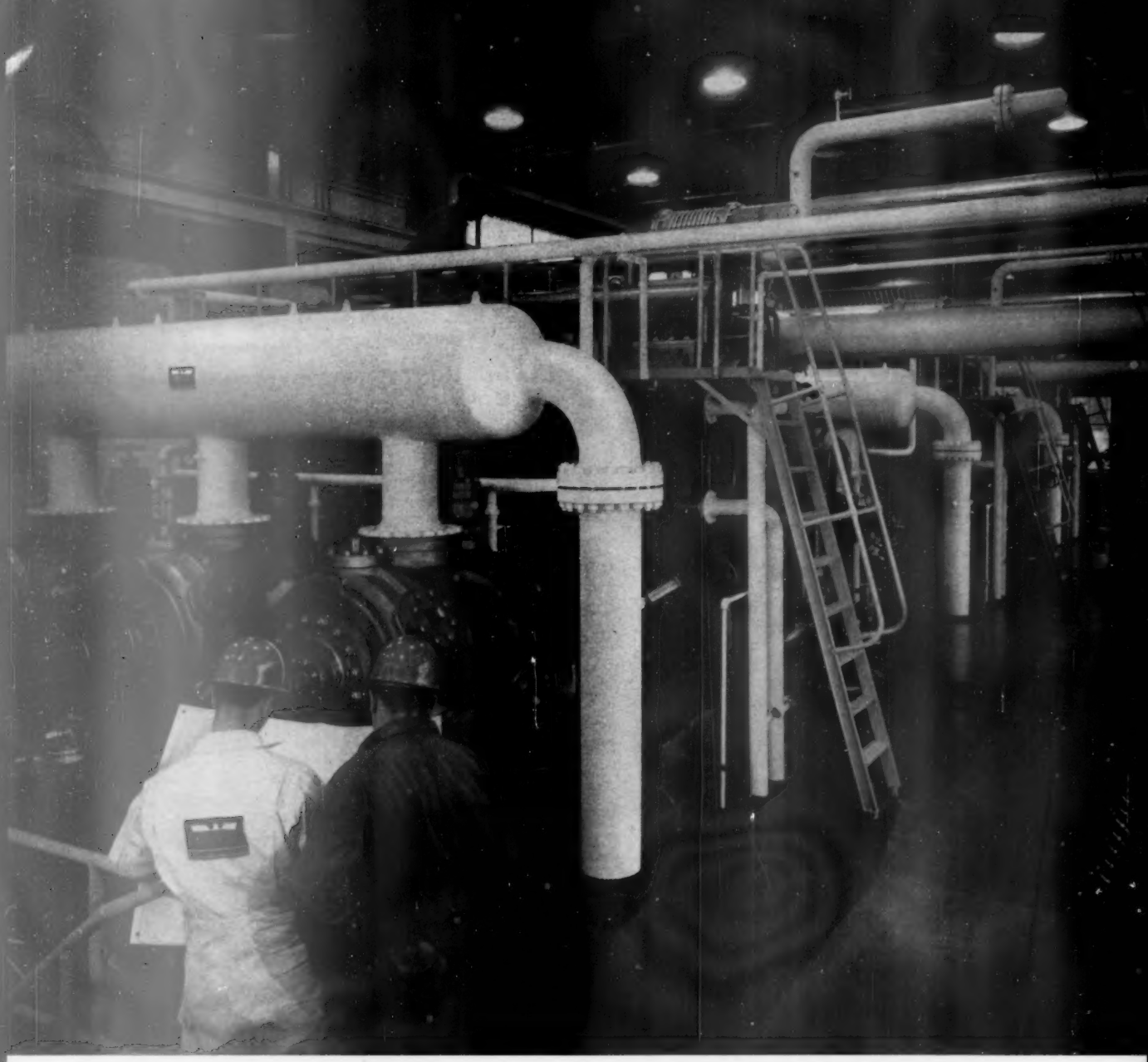
A Semi-U dozer for dirt and rock

B U dozer for big yardage in loose material

C Angling dozer for pioneering, filling, sidecasting

D Straight dozer with tilt feature for added versatility in all work

E Hydraulic angle and tilt dozer for multi-purpose work



Trans-Canada Pipe Lines Limited Chooses Worthington SUTC's . . .

FOR FIRST FULL AUTOMATION

At central control, the dispatcher pushes a button. At the compressor station miles away, a solenoid throws an air valve. Engine and compressor cylinders begin purging . . .

At 6 seconds, ignition actuates, fuel is admitted and the engine slowly accelerates toward 160 rpm. At 20 seconds the compressor cylinders stop purging. In 5 minutes, the engine-compressor is ready to be brought on line.

This is a glimpse of normal operation of Trans-Canada Pipe Lines Limited's Maple Station—the first to be fully automated by this pipeline company. Three Worthington SUTC engine-compressors operate in pre-set sequences according to signals from the dispatcher who, though 25 miles away, could be a thousand.

These new SUTC's have a higher compression ratio for increased efficiency; improved handling of heat load through new computer-designed Turbo-Chargers; and new bearing construction. Cylinder parts and Double Deck valves were manufactured in Canada.

The station organization chart shows the benefit of these automated SUTC's. This station has no operators. This saves initial cost of four houses and salary and overhead for the operators.

For complete information on SUTC's for automated or conventional installations, call your nearest Worthington District Office. Or write Worthington Corporation, Dept. 43-22, Buffalo, New York. In Canada, Worthington (Canada) Ltd., Brantford, Ontario.

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Armco Line Pipe can help you cut costs, thanks to 132 different diameter-wall thickness combinations. You don't pay for "extra" steel—only for the steel you need. Here, for example, is Armco Line Pipe being installed near Hobbs, New Mexico, for Pan American Petroleum. Pipe diameter is 12¾", wall thickness is .172—the *exact* size necessary for pressure requirements. Let us help you with *your* pipeline problems. Mail the handy coupon.

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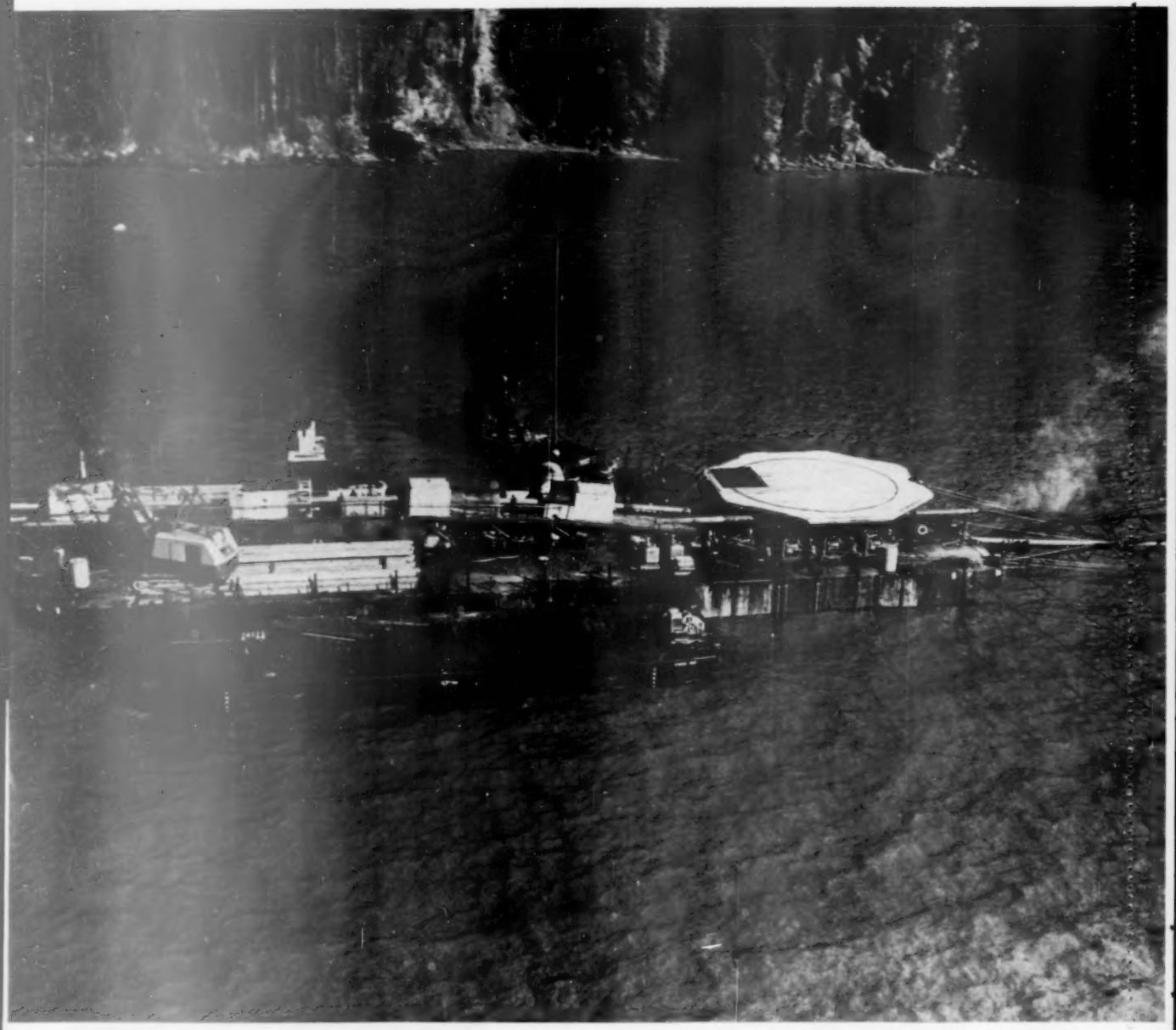
Defiant Alaskan "Arm"



Modifications especially for Turnagain Arm difficulties can be seen on pipelaying barge, Tidelands No. 6,

by K. M. McClain

Is Defeated

"Never in the history of pipeline laying," recalls a veteran inspector, "has a pipeline been started that wasn't finished." A 74-mile pipeline to take gas to Anchorage, Alaska, almost proved him wrong . . . but not quite . . . for finally it has been completed.

How it was done is a story worth telling.

Construction of any pipeline has its pressing headaches, but no one will easily forget the Turnagain Arm — or underwater portion — of the pipeline for Anchorage Natural Gas Corp. and Alaska Pipeline Corp. Nature's insurmountable forces on the Arm — high tides, strong winds, swift currents, glacial silt and oozing mud — brought failure to the first attempt at construction.

As these forces remained unchanged, observers began to wonder if the Arm could be conquered.

Those Involved

The $16,000,000 pipeline was a sizable headache for Delta Engineering Corp., agents for the gas corporation, and more so for Sharman, Allen, Gay and Taylor, Inc. whose task it was to lay the 8.5 miles of dual 12¾ in. OD by 0.500-in. wall thickness pipe across the Arm.

By road miles, the gas wells are located 210 miles away, or 85 miles across the Arm. The overland pipeline links to the transmission line at Burnt Island, then across the Inlet 8.5 miles to Potter and the distribution system at Anchorage.

Beginning at Potter last season, crewmen laid dual lines to the first channel. Work at this point was suspended. Equipment usually adequate for this type of construction was unequal to the task of completing the crossing of the main channels and the sand bar between the channels.

Unquestionably, Delta worked relentlessly formulating plans to get the project underway

Workmen apply concrete coating over welded joint.

View from stern of laying barge, with Burnt Island in background. Pipe supported by stinger is lowered into trench made by jets.

Aboard Tidelands No. 6, welding stations are on pipe ramp . . . compressors and winches in foreground.

Helicopter arrives at landing area on Tidelands No. 6.

as soon as the floe-ice made it possible for the operation to resume.

This season, work started on the opposite side — Burnt Island — but with a specialized equipped barge.

"At low tide, we couldn't work but sure could feel the barge rock to and fro on that sand bar," said a crewman. This gives one a small conception of the terrific underwater pressure. Sea-faring men on a nearby tug accustomed to such antics of the elements jeered, "We'll stand by and rescue you." Ironically, it was their twin-engine tug that sank.

Barge Is Modified

A newcomer to the scene, J. Ray McDermott & Co., Inc., Sharman's parent organization, was fully prepared to meet the challenge. Its Tidelands No. 6 pipelaying barge, despite past marine installation achievements, underwent certain modifications on its mechanical features for the Alaskan job. This not only required weeks of careful planning but diligent work in designing, building and installing specialized equipment.

When modified, a 215-ft long pipe ramp (stinger) that cantilevers over the barge gave the pipelaying area 270 ft in length. In addition, the barge was equipped with welding machines, X-ray machines, pumps, air compressors, deck machinery, anchors, helicopter landing area, tools and other intricate gear.

On February 4, 1961, the mammoth barge, 240-ft long by 72-ft beam, towed by the 97-ft long by 26-ft beam 1300-hp ocean-going tug, the R. Thomas McDermott, sailed out of Morgan City, La. Three additional barges completed the fleet . . . the New Mexico, the Utah and the service barge, TJ361, 135 ft long by 40-ft beam, which was used to transport pipe and other equipment necessary for maintenance and service. By March 15 the fleet passed through the Panama Canal. Its arrival in Anchorage might have been sooner, but 10 days were spent in Seattle to load vital equipment.

Land Line Progress

Meanwhile, mid-winter operations in the field were progressing rapidly. Despite snow, Williams Brothers Co. was back on the job finishing the overland transmission line. Last season, out of the 74 miles of this line, 64.2 miles had been completed. Cost of the overland 12¾ in. pipe, with a 0.250-in. wall thickness installed in 16-in. casing is estimated at $2,000,000.

H. L. "Red" Davis, general superintendent, and Dick Hamilton, spread foreman for Williams Brothers, set up camp a few miles from Turnagain Arm, using tents only as a shop since men were flown to and from work each day.

Here, since the last few miles involved swampy land, Delta officials decided to weld the pipe while the ground was frozen. Later, ditching and side boom tractors would follow up, burying the coated pipe.

Workmen moved ahead of the welding crew, heating the pipe with butane torches that thawed any ice or frozen debris in the pipe, enabling a swabbing device to clean the pipe before joints were welded together. After the welder applied third and last bead to the joint in the pipe, the helper chipped and brushed the weld.

Although this crew worked behind the major portion of the project, they reversed direction, working to meet finished welders, if initial construction advanced more rapidly.

Alfred E. Meacham, Delta inspector, observed the crew's progress by means of the reliable helicopter.

Williams Brothers earlier, in clearing and grading the right-of-way, used material and

With stinger in position and jets operating, Tidelands No. 6 lays pipe.

equipment available in Alaska. But highly specialized equipment for treating the pipe, for example a cleaning and priming machine manufactured by Morris-Young-Owens Co. was used, as well as gunnite equipment that coated the pipe with concrete-type material at the rate of more than a mile of pipe a day, providing negative buoyancy and protection. This was applied by Rosson-Richard Co.

Alaska Pipeline Co. furnished pipe, concrete, weighs, coating and wrapping material, so these costs are excluded in all estimates given.

Barge Takes Over

In May, the fleet dropped anchor to start its herculean task on Turnagain Arm.

Two crews worked a 24-hr shift, 12-hr in each shift, with a 30 min lunch period at noon and midnight. Chester Lake was in charge locally and Cecil Potter was superintendent for J. Ray McDermott & Co. and Hank Ingerman was project manager.

This is how the $3,500,000 underwater crossing was accomplished in record time:

With the exception of coating, preparations for pipe burial were made aboard the barge. The concrete-coated pipe was delivered in 40-ft lengths to the service barge, then hoisted with a crane to the pipelaying barge. Here, the pipe followed the assembly line, running the length of the 240-ft barge and extending 200 ft beyond it. The work of eight welders was carefully inspected with X-ray. Attached to the barge were eight 6000-lb sea anchors, with a pulling unit having 2300 ft of cable winching the barge forward, permitting the pipe to move down the stinger to which were attached flexfloats. The stinger then fed the pipe overboard into a trench made with 16 jet pumps. Within a few hours shifting silt covered the pipe.

As the operation was repeated, jetting slowly from Burnt Island across the mouth of the Arm, connections were made to that portion installed last year. At low tide final tie-ins were made on either side of the Arm by land-based equipment. These welds were X-rayed and the joints covered with concrete.

Testing The Line

Early in June, Kenneth Sheppard, vice president and director of Alaska Pipeline Co. announced the dual pipeline's completion. Although this gave assurance to housewife, commercial consumer and future industry of the availability of natural gas for the first time in Alaska's history, the final step — testing — was yet to be accomplished.

High pressure testing on the Kenai-Anchorage natural gas pipeline from the wellhead to Potter on the north side of Turnagain was successful. This 60-mile section was tested at 1329-psi with gas from the producing wells. During the tests, every precaution was taken — occupants of 20 trailers adjacent to the pipeline area were evacuated and reimbursed for their added expense.

Later, for safety, the section from Potter to a distribution valve gate at Tudor Road and an extension to Bragaw will be tested by water pressure.

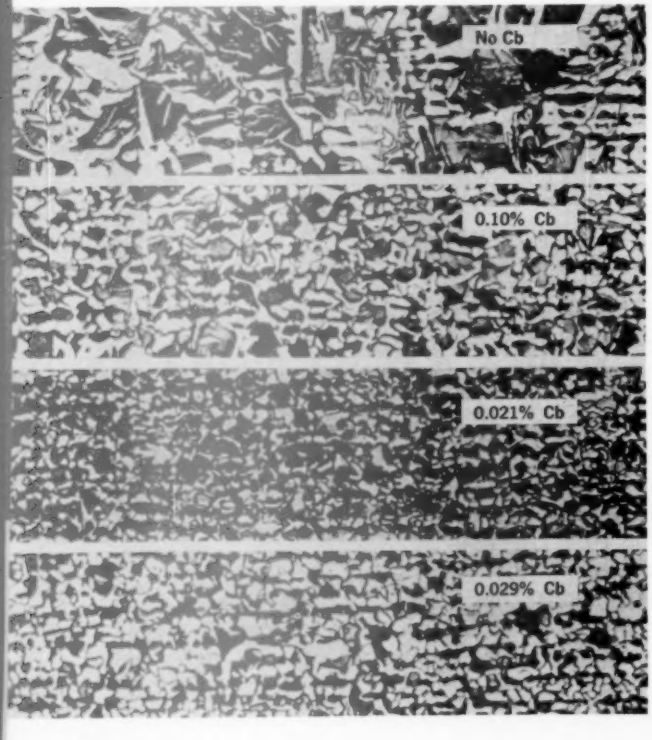
Physical activity has ceased on Turnagain Arm. Without any fanfare the Tidelands No. 6, the R. Thomas McDermott, the New Mexico, Utah and the TJ361 pulled anchor and headed for New Orleans, La. Undoubtedly, their logs bulge with important data. What seemed to be astronomical difficulties no longer exist — an engineering achievement of historical significance in pipeline construction has been accomplished.

■

XC-60=

Welding the pipe at sub-zero temperature. Note frost.

A fine grain structure is the outstanding characteristic of the new steel. This shows the effect of columbium on size of grain structure.



A new columbium-additive pipe steel may fill pipeliners' longtime need for pipe combining high minimum yield strength with all-weather field weldability.

Adding small quantities of columbium to mild carbon steel greatly increases tensile strength, improves toughness and — most important — preserves the weldability inherent in mild carbon steel.

In tests the new XC-60 pipe proved easily weldable with standard equipment and by conventional methods through ambient temperatures from room temperature down to —25 F without need for preheating.

The new steel was developed and tested in a two-year program just completed as a joint undertaking by Great Lakes Steel Div., National Steel Corp., Detroit; Natural Gas Pipeline Co. of America, Chicago; and A. O. Smith Corp., Milwaukee. H. C. Price Co., Bartlesville, Okla., conducted many of the field welding and performance tests.

What Program Included

The program included design, engineering, metallurgical and cost studies of the new steel from open hearth to pipe fabrication and included field installation of a 47-mile, 20-in. line in Texas for evaluating performance in actual gas transmission service. Sub-zero welding tests were made in refrigerated railroad cars.

These further facts were brought out in tests:

1. Because of columbium steel pipe's increased ductility, thinner wall pipe can be used.

2. It requires less weld metal and less weld heat than conventional high strength pipe steels.

3. Monetary savings result from less steel tonnage per mile and reduced costs for welding, material handling and freight.

Strength + Weldability

Possessing a 60,000-psi minimum guaranteed yield strength, the new steel achieves its higher strength levels through a lower carbon-manganese chemistry — about 30% lower in carbon and 25 to 35% lower in manganese than the highest strength pipe steels now in general use.

Chemical analysis of the pipe steel tested was:

Carbon	0.20 to 0.27%
Manganese	0.89 to 1.28%
Columbium	0.006 to 0.018%

A semi-killed steel, it has a very fine grain structure.

The test installation, stretching out over the plains of South Texas between Falfurrias and Hebbronville, has been in high capacity service for more than nine months without incident. Prior to its being placed in operation, burst tests found it to have yield strength in excess of 80,000 psi. Field welds were found by radiographic inspection to be 100% free of defects.

The 47 miles of pipe, weighing approximately 6580 tons, was fabricated of columbium-additive steel in ¼-in. thick plate. To obtain the same design strength (60,000 psi) would have required 8225 tons of X-52 grade pipe in a 5/16-in. wall or a 25% heavier pipe wall thickness.

"This 47-mile installation rates classification as the strongest and probably the freest of weld defects of any natural gas transmission line ever built," according to A. G. Barkow, superintendent of inspection for Natural Gas Pipeline Co. of America.

All-Weather Weldability

Barkow, author of a comprehensive technical report on the XC-60 development program, emphasizes the all-weather field weldability of the new pipe steel is equally as important as the higher strength levels that permit design of thinner wall pipe.

Cold weather can be a formidable enemy to field weldability of high strength pipe because high content of carbon and manganese — necessary for strength — is adversely affected by fast cooling rates during field welding at low temperatures.

Depending upon how cold temperatures are in relation to pipe wall thickness, conventional high strength line pipe steels may require preheating for field welding and controlled cooling following welding. The critical point is considered to be 40 F or colder.

Laboratory tests conducted during the development program found XC-60 pipe has a 100% tendency to resist underbead cracking in weldments.

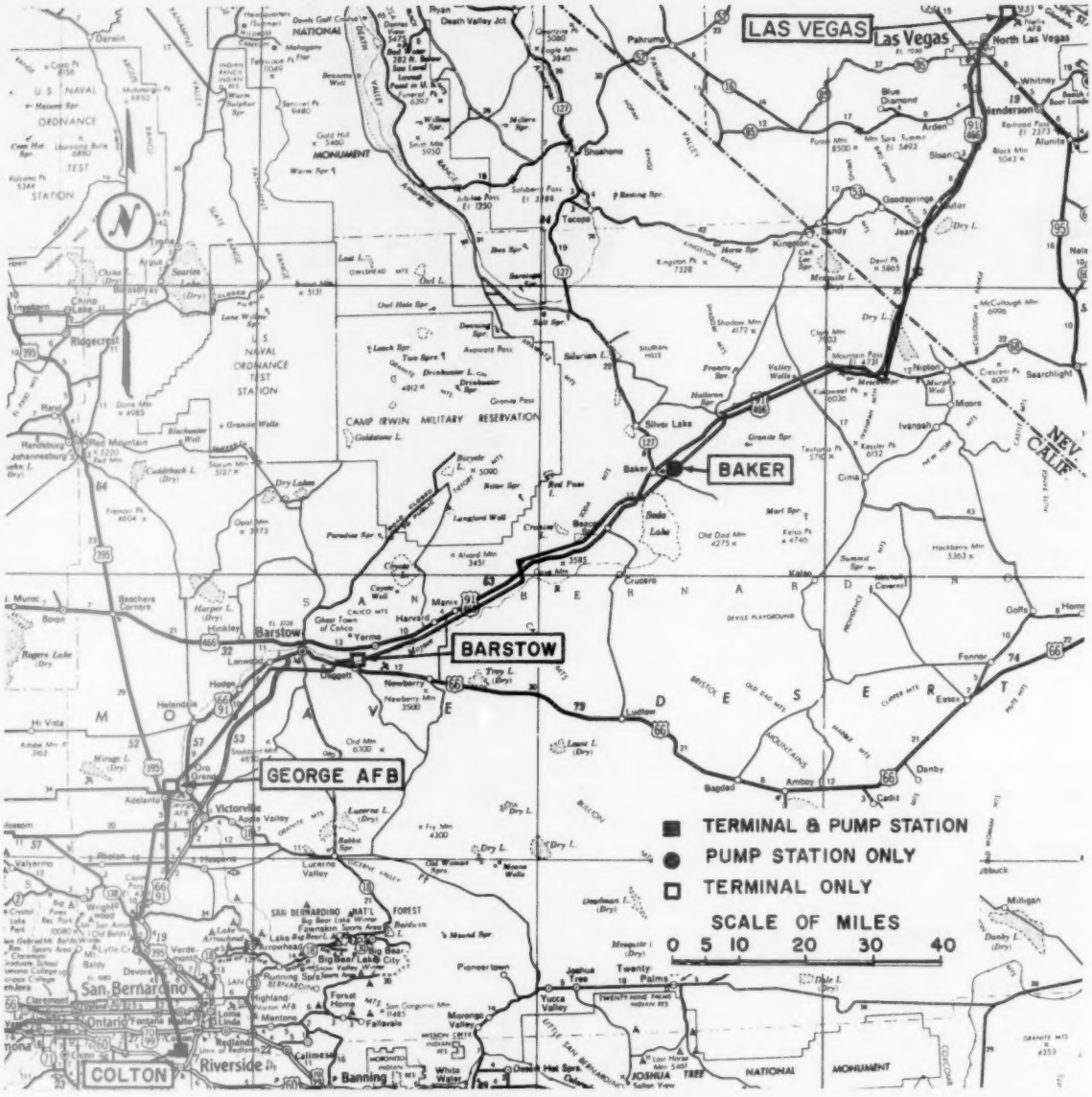
All pipe for the two-year project was fabricated by conventional methods in plants of A. O. Smith Corp. It was expanded by both hydraulic and mechanical methods, using the same degree of expansion as in normal practice.

In field installation the XC-60 pipe was bent as easily as conventional high strength pipe. Bending equipment, however, had to compensate for the pipe's tendency to spring back into original shape.

The program also included fabrication of 4.25 miles of 24-in. pipe and 1.75 miles of 30-in. pipe. In these, XC-60 pipe promises material savings of 35 to 37 tons per mile, Barkow's report states.

Steelmen and pipeliners are hopeful that the research and development program on the columbium steel will eventually produce a pipe steel with a minimum yield strength of 70,000 psi. Ultimate strength of steel produced in several heats at Great Lakes has been as high as 101,000 psi with yield strength of 71,000.

High yield strength, ductility and weldability of the pipe may also help foster greater use of thin-wall pipe in both small and large diameter sizes for all types of pipeline service. ■



Route map of Calnev Pipe Line Company

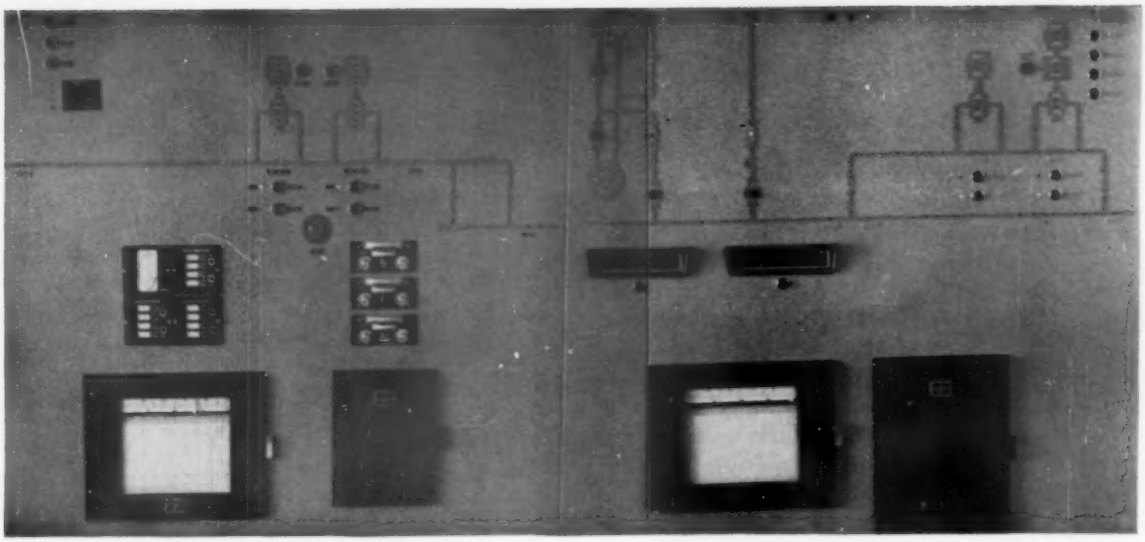
Special System Controls Special Line

by Richard Gode

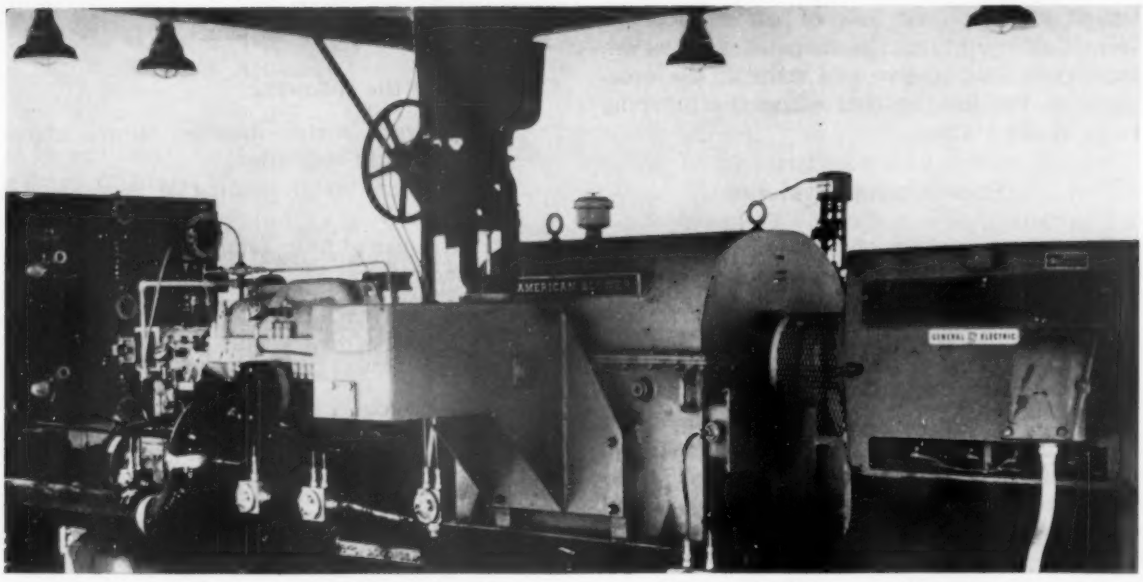
Twenty separate products are handled in a standard batching cycle by the new Calnev Pipe Line Co. system that extends from Colton, Calif., to Las Vegas, Nev. A special control system prevents possible interface mixing by keeping the line packed and under pressure at all times.

Design of the control system takes into consideration further problems resulting from rugged terrain, varying elevations, remote locations and minimum operating personnel.

Result is a system that permits each item (supervisory, telemetering, controls and interface detection) to operate independently. Loss of communications or malfunction of any part will not necessarily shut down the whole opera-



Colton control and system supervisory panel.



Close-up of No. 1 unit at Baker station showing speed reducer controlled by electro-hydraulic operator.

tion. All parts are so tied together, however, that the dispatcher can operate the line to best advantage and deliver products according to shippers' requirements.

Remote, Rugged System

This 248-mile, 8-in. line, with an ultimate capacity of approximately 21,000 bpd, crosses two mountain ranges and the Mojave Desert to transport diesel fuel for the Union Pacific Railroad, jet fuel for George and Nellis Air Force bases and gasoline and truck diesel fuel for commercial shippers. It was designed, engineered and constructed by Williams Brothers Co., Tulsa contracting firm and one of the two major stockholders in Calnev Pipe Line Co. The other major stockholder is Union Pacific Railroad.

There are four delivery terminals and one intermediate station on the system, as well as the originating station at Colton. There are two 350-hp pumping units in each station. Pumps and motors are designed to be interchangeable.

Elevations of the various delivery and control points along the line from Colton to the Las Vegas terminal are:

1027 ft — Colton
4425 ft — Cajon Pass
2900 ft — George Air Force Base
1966 ft — Barstow terminal
1185 ft — Baker station

4762 ft — Mountain Pass
2030 ft — Union Pacific take-off
1908 ft — Las Vegas terminal

Pressures at critical points are transmitted to the system control board at Colton station and recorded. The dispatcher uses this pressure information to control rates of pumping and delivery of various products into the terminals.

Pumping rates are varied by control of two pumps and the suction pressure controller at Baker station. One pump is driven through a variable speed drive. In operation, a combination of the two pumps will produce a variable pressure across the pumps from approximately 400 to 1750 psi. With this arrangement for pumping, rates vary infinitely from 7000 bbl per day, when bypassing Baker station, to 21,000 bbl per day with both units pumping.

Baker station is at the hydraulic mid-point of the system. It is fully protected for continued operation on loss of communications from Colton station. The dispatcher, however, supervises this station and controls the pressures in the line by controlling the pumping rates of the station.

Supervisory Systems

Supervisory system of Calnev Pipe Line Co. is divided, with one section of the line under control of the system dispatcher at Colton station, and the delivery of products into Union Pacific terminal and Las Vegas terminal under supervision of the terminal operator at Las Vegas. Operators at Colton have control of George Air Force Base, Barstow terminal and Baker station. Combining the controls and intelligence received over the supervisory and telemetering system with the local controls, the dispatcher is able to control flow and pressures in the system all the way to the second mountain pass. The local control panel and supervisory panel are joined in a continuous graphic representation of the system to aid the dispatcher in this operation.

The Colton dispatcher can perform the supervisory functions for each delivery point as follows:

George Air Force Base

1. Controls
   a. Open and close incoming line motor operated valve with position indicating lights showing on panel.
   b. Open and close No. 1 tank motor operated valve with position indicating lights showing on panel.
   c. Open and close No. 2 tank motor operated valve with position indicating lights showing on panel.
2. Monitor the following:
   a. Transfer pump running light.
   b. Tank No. 1 high level control and alarm with light indication.
   c. Tank No. 2 high level control and alarm with light indication.
   d. Delivery meter impulse failure alarm with light indication.
   e. Meter reading of products delivered.
   f. Strainer or filter failure alarm with light indication.

Barstow Terminal

1. Controls
   a. Open and close incoming line motor operated valve with position indicating lights showing on panel.
2. Monitor the following:
   a. Delivery meter impulse failure alarm with light indication.
   b. Delivery meter reading of products delivered.
   c. Strainer of filter failure alarm with light indication.

Baker Station

1. Unit Controls
   a. Start and stop unit No. 1 and condition indicating lights showing on panel.
   b. Start and stop unit No. 2 and condition indicating lights showing on panel.
   c. Control of motor driven set point unit on suction pressure controller.
2. Station Controls
   a. Low a-c or low d-c control volts (one light).
   b. Low suction pressure, or high discharge pressure (one light).
   c. Low volts — reverse phase (one light).
   d. High bypass pressure (one light).
3. Monitor the following: unit No. 1.
   a. Pump case temperature (one indicating light).
   b. Vibration, pump seal failure, pump outboard bearing temperature, and pump inboard bearing temperature (one light).
   c. Motor winding temperature, motor outboard bearing temperature, motor inboard bearing temperature, motor

overload and current unbalance (one light).

d. Incomplete sequence (one indicating light).
e. Four bearing temperatures and one oil temperature for variable speed drive (one indicating light).
f. Low oil pressure for variable speed drive (one light).

3. Monitor the following: Unit No. 2.

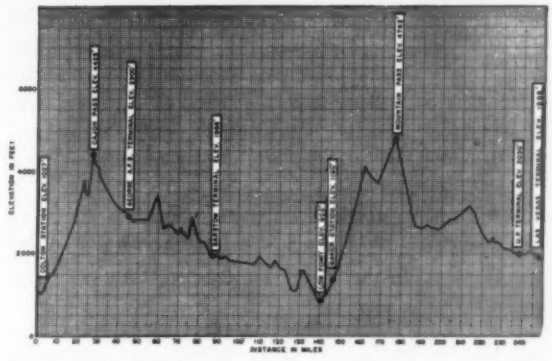
a. Pump case temperature (one indicating light).
b. Vibration, pump seal failure, pump inboard bearing temperature, and pump outboard bearing temperature (one light).
c. Motor winding temperature, motor outboard bearing temperature, motor inboard bearing temperature, motor overload and current unbalance (one light).
d. Incomplete sequence (one indicating light).

In addition, the supervisory system has the normal functions of:

1. Indication recall button to check the position of all controlled devices.
2. Data recall button to verify data displayed.
3. Lamp test button and flasher.
4. Alarm and alarm silence button.
5. Selective alarm and storage for all alarm signals.
6. Communications circuit failure.
7. Reset of controls for No. 1 and No. 2 unit pump case temperature, low suction pressure and high discharge pressure.

A section of the supervisory system was installed on the Las Vegas end of the line for control of Union Pacific terminal by the Las Vegas terminal operators. This operation was planned because it is a one-product, one-customer delivery in the batching cycle. The supervisory system includes the open-stop-close function and position lights for the delivery valve. Other essential information for the operator is as follows:

1. Strainer differential pressure alarm with light indication.
2. High sump level alarm with light indication.
3. High pressure alarm with light indication.
4. Delivery meter impulse failure alarm with light indication.



Profile of Calnev Pipe Line system. Elevations vary from 922 ft to 4762 ft.

5. Delivery meter reading of products delivered.

This section of supervisory equipment also includes:

1. Indication recall button to check the position of all controlled devices.
2. Data recall button to verify data displayed.
3. Lamp test button and flasher.
4. Alarm and alarm silence button.
5. Selective alarm and alarm storage for all alarm signals.
6. Communications circuit failure.
7. Local and remote switch to permit local control.

Telemetering System

Purpose of the telemetering system is to keep the dispatcher at Colton station informed of the pressures at critical points along the line. The following points will indicate if the line is packed and operating properly:

1. Line pressure at top of Cajon Pass.
2. Line pressure at George AFB.
3. Line pressure at Barstow terminal.
4. Suction pressure at Baker station.
5. Discharge pressure at Baker station.
6. Pump speed at Baker station.

Equipment consists of pulse duration type signal, with a maximum time cycle of five seconds and a standard six point strip chart receiver. The receiver is mounted on the control board at Colton.

The six point receiver and chart record is useful as a continuous comparison of the control points by the operator. It is anticipated that experience in interpreting pressure comparisons will be of value to indicate beginning and ending of deliveries, products in the line,

scraper passage, and line failures. The dispatcher controls his pumping to hold a predetermined pressure at all pressure points, thereby keeping the size of the interface at a minimum.

The telemetering channel, supervisory channel, and voice channels are all separated for continuity of service.

With this channel arrangement, the pipeline will continue to function with the loss of any one or two channels, by changing the operating procedure.

On the Las Vegas end of the line, pressure at the top of Mountain Pass is transmitted by a Bristol metameter transmitter and receiver system direct to recording controllers at U. P. take-off and Las Vegas terminals. The control valve and controller at each location will keep the pressure constant coming over the mountain, according to the information received from the transmitter. Using the control valve to maintain a constant pressure on Mountain Pass, the rate of delivery can be controlled by the Colton station dispatcher.

Controls and Controllers

Controls and controllers are designed to perform the following functions:

1. Control main line pressures.
2. Regulate flow.
3. Protect main line and equipment.

The system, because it crosses two mountain ranges, will be operated at pressures near the working pressure limits of the main line pipe. Maximum throughput is attained by trimming the centrifugal pumps to operate at maximum pressures with the lightest product and controlling all other products.

Controls necessary to perform the above functions at the various control points are:

Colton station. At this originating station, electronic controllers are used for motor overload and discharge pressure. Motor overload controllers are necessary only on start-up. The discharge pressure controller is used to regulate the flow and protect the pipe from over pressure according to the products being pumped.

George AFB and Barstow terminal. Both have a flow controller and a line pressure controller. Normally, delivery to these stations will be bled off the product passing the terminal. The flow controller is set to make delivery at rates that will not upset the pressure control on the system. The pressure controller overrides the flow controls to hold a minimum pressure on the main line.

Baker station. This station has suction pressure control as well as discharge pressure and motor overload controls. The controlled element at this station is a variable speed fluid drive on one unit. The pressure control of the entire line from Colton to this point is controlled by the suction pressure at Baker. The set point of the suction pressure controller can be changed remotely over the supervisory system by the dispatcher at Colton.

Union Pacific and Las Vegas terminals. Instrumentation at Union Pacific and Las Vegas terminals consists, as mentioned before, of one special pressure controller with the sensing element located on Mountain Pass. The sole function of this controller is to maintain a pressure on Mountain Pass and thereby keep the line packed into the terminals.

Interface Detection

Products in this line follow each other without mechanical separation. Separation of products at delivery points is made on indication of product change by electronic interface detectors.

A remote detector is located in the line three to five miles ahead of each terminal and another detector in each terminal. The records for both are made on one chart.

In operation, the remote detector, upon a change in product in the line, will sound an alarm to alert the terminal operator to prepare for receiving a different tender. The operator will determine from the record of the remote detector at which point on the changing curve he should do his switching in the manifold. The switch is made when the record of the local detector matches the selected point from the remote detector. Knowing the size of the tender and using the information furnished by the interface detector, the terminal operator will be able to separate the products with a minimum of contamination.

About the Author

Richard Gode served as project engineer for the Calnev Pipe Line project. He is project engineer for Williams Brothers Co. and a registered professional engineer in Oklahoma. He holds a BSEE degree from Oklahoma State University. Before joining Williams Brothers Co. he worked in Gulf Oil Co.'s production department, Shell Oil Co.'s geophysical department, was an electrical design engineer for Public Service Co. of Oklahoma and electrical and hydraulic engineer for Service Pipe Line Co.

□

Part 9: Telemetering

by Max T. Nigh

In engineering complex data handling systems, you have an ideal opportunity to apply principles that regard the overall efficiency of the system. This is "systems engineering".

It is opposed to past practice, in most instances, of perfectly engineering each instrument or component independent of the entire system and requires a look at techniques and disciplines — what has to be done and how it might be done — not to be found in textbooks and courses.

You must ask yourself:

Where is the best location for analog-to-digital conversion and how is the distance problem, in the case of pipelines, resolved?

What about degeneration of accuracy of measurement signals?

What benefits will computers contribute as part of an automation system?

Where should computers be located?

The answers provide a close blending of engineering for maximum efficiency.

Best Location for Conversion

At some point in any data system the data is finally put in digital form. Modern digital computers manipulate digital data many times at electronic speed with no loss in resolution or accuracy. This manipulation of digital data can be extremely economical as compared to manipulation of analog data when you have the necessary volume of data. It is entirely logical, then, for information used to run industrial plants utilizing physical measurements to be most conveniently and economically handled in digital form.

To preserve accuracy in digital control systems, you must convert information to digital form as soon as possible in the flow of information through the system.

In applying this concept to pipelines, you must convert at point of measurement, which is often many miles from the location desiring the information. How do you resolve the distance problem? Think of all equipment as being at one location. When Thomas A. Edison was testing the first trans-Atlantic cable in England before it was installed, he evaluated his system by coiling cable inside large tanks filled with sea water. The cable of the correct total length was then tested for functioning as a telegraph system with both ends physically located at the same place. Coiling up the cable permitted the inductive field around the cable, as the line was pulsed, to cause serious limitation on the speed with which messages could be transmitted, a problem which disappeared when the cable was laid across the ocean. This, however, was a speed consideration and did not mean that the efficiency of the check-out system was seriously restricted.

This check-out procedure is used with all pipeline automation systems today. Long distance transmission of data does not affect accuracy and resolution if you have introduced necessary validity checking.

Apply this same idea to the pipeline telemetering system by visualizing remote locations as being in the same room with the central processing equipment. Machines do not recognize distance. They only appreciate limitations of speed in and out of the various parts of the system. Physical distances between parts of the system are of no importance.

When you view such a system at one location, you see so many digital transformations occurring in the system that you wonder why you don't get your measurements in digital form directly to save the need for conversion. Unfortunately this is not possible in most cases today, but does point the direction in terms of future technology!

One principal design philosophy emphasized in Part 8 of this series was the need to eliminate degeneration of accuracy of measurement signals. It was pointed out that repeated analog transformations are undesirable because each

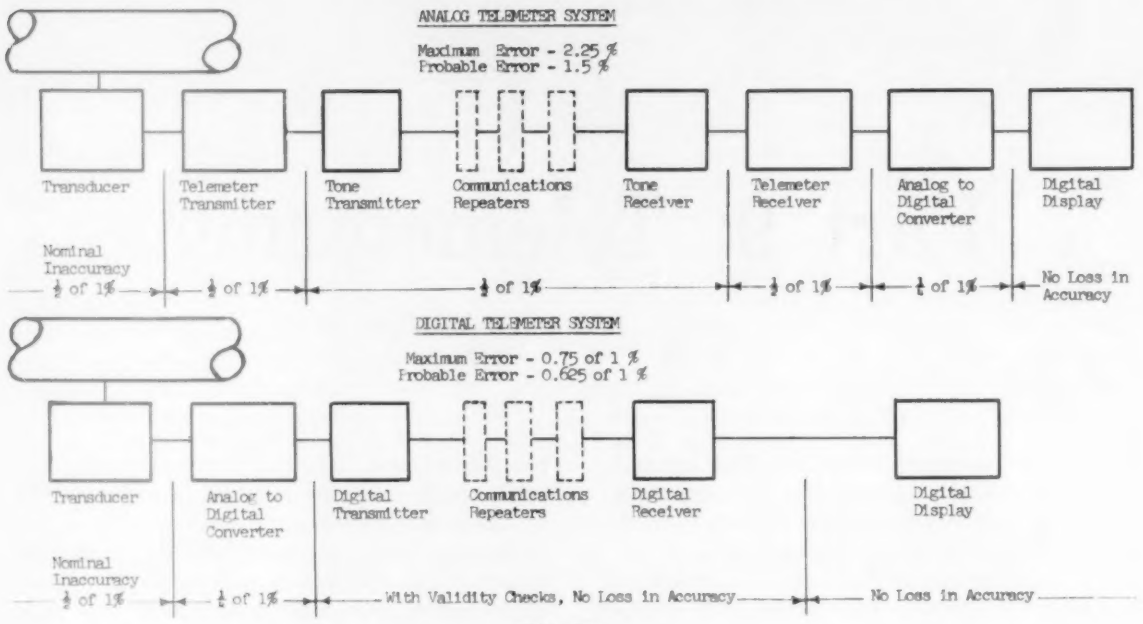


FIG. 32.

transformation of the analog signal, either through instrumentation or communications, creates a loss in accuracy and resolution. The degeneration in accuracy is in terms of zero shift and span or proportionality change, and angularity or nonlinear change.

It was asserted that the fundamental advantage of digital systems is its ability to eliminate loss in accuracy or resolution of the information no matter how many times the information is transformed at the same level, within the resolution of the digital system.

Fig. 32 shows loss in accuracy for a typical analog telemetering signal and compares it with the accuracy possible with digital telemetering of the signal. With digital systems, then, we have a means of control over the possible accuracy and resolution and can evaluate what performance level the system can achieve.

Simulation Measurement

To date, we have been concerned with direct measurement of each piece of information wanted. It is evident in looking toward future technology that we will not only have superior measurement but the pipeline industry will be taking advantage of the benefits of computers.

Computers not only provide easy means for assimilation and manipulation of measured data but permit estimation of data not directly measured. This type of data is of real value in operating any industrial unit using large amounts of energy and handling a valuable product in an expensive facility. Certainly pipelines meet these qualifications!

It is quite common to measure and telemeter suction, case, discharge, pressure and flow from each pumping station on the line into a central point. Assuming a reasonably accurate temperature profile and product viscosity, pressures along the line can be estimated with satisfactory accuracy when flow rate in the pipeline is known. If you know the status of booster station machinery, you can estimate pressures at booster stations and thence make necessary evaluations for optimizing the operation of the line — a job any dispatcher does his best to achieve with the information he has at hand.

Spot checking of pressures periodically will permit increasing the accuracy of the temperature profile and product viscosity data. Flow alone permits estimation of inventory in tanks without measuring the tank levels. Not only will a computer be useful in estimation of pertinent operating data, but its use can be extended to other areas of dispatching and its associated "housekeeping." Batch arrival and departure times, current pipeline efficiencies, as well as inventory status for evaluating schedules, are a few uses for computing equipment.

The economic location for the computer is at the central location shown in Fig. 33. This location is strategic not only due to cost and efficiency, but also because it is the only place a pipeline system can be evaluated for optimizing its energy consumption. This assertion is pertinent to systems with variable flow rates and products of different viscosities. If rate of flow is held constant and viscosity does not change with various batches, then energy can be opti-

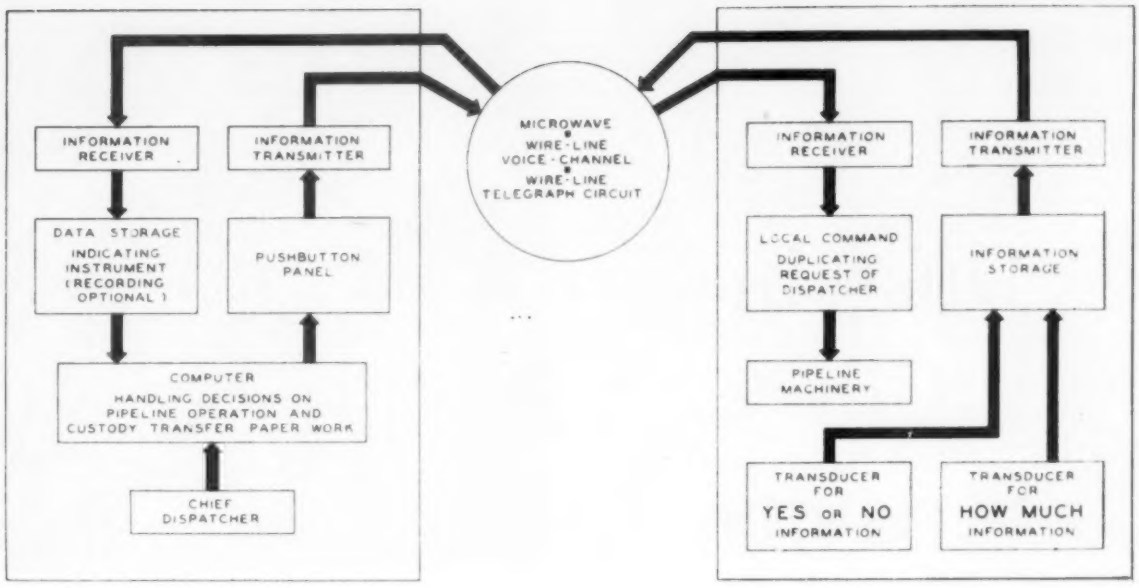


FIG. 33.

mized at each station. This situation is not a common occurrence in modern liquid systems.

Centralizing the computer for these data processing functions brings up another question concerning systems engineering in the area of organization and function of the business.

Decentralization

In management, the policy of centralized vs decentralized business organizations is constantly reviewed. Advantages can be obtained from either policy.

Decentralized authority is in wide use and is providing management with a sound operating basis when it is used in the pipeline industry. If such a philosophy is in effect, can centralized monitoring of operations be compatible with decentralized authority?

Centralized control and monitoring permits minimum cost per unit of control and is the only manner in which all parts of a system can be reviewed to obtain optimum operations. Centralized monitoring is used because of its economic feasibility in evaluating the overall system. An economic computer for small sections of pipelines seems unfeasible at present.

Even though information is handled on a centralized basis, it need not be interpreted to necessitate centralized authority. Effective management action on a decentralized basis can still maintain responsibility for decisions without modification. Centralized information handling can be used as a reference for checking on decentralized authority as well as an aid to it. With proper planning, centralized monitoring of pipeline operations with a digital control system need not be inconsistent with a management policy of decentralized authority.

Industry Applications

Principles of information handling discussed in this series will find application in information systems in all pipeline activities; gas transmission and distribution; as well as products, chemical and crude oil pipeline. Digital control systems utilizing the techniques discussed will integrate industrial plants so that centralized control of a widely distributed industrial system can be achieved effectively.

Conclusion

When you think of automation equipment making life better and easier, appreciate the simple fact that the cost of human energy is 480 times that of electrical energy. The harvest from this kind of saving can only mean a higher standard of living for everyone.

Without using advanced mathematical theories or singling out specific pieces of equipment, this series on digital telemetering has presented concepts important to present and future automation primarily to help you better understand sophisticated machine technology and its function in your pipeline activities.

The author acknowledges the assistance of Carl McCullough and Jack Vaughn, design engineers with Service Pipe Line Co., Tulsa, Okla., in preparation of the drawings for this series.

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Dust in Gas Streams

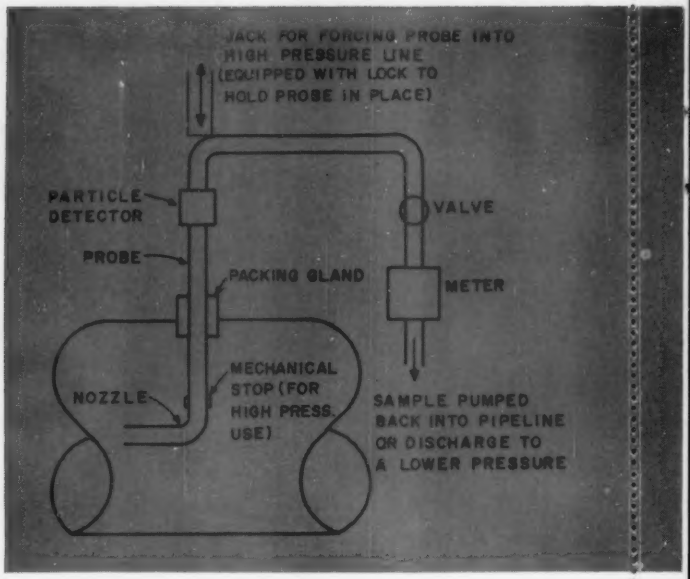
JACK FOR FORCING PROBE INTO HIGH PRESSURE LINE (EQUIPPED WITH LOCK TO HOLD PROBE IN PLACE)
PARTICLE DETECTOR
VALVE
PROBE
PACKING GLAND
METER
MECHANICAL STOP (FOR HIGH PRESS. USE)
NOZZLE
SAMPLE PUMPED BACK INTO PIPELINE OR DISCHARGE TO A LOWER PRESSURE

FIG. 10. Recommended sampling system.

Part 3-B: Recommendations for Sampling

Most important parts of a recommended sampling system are the sampling probe and nozzle.

The probe, to be inserted and removed without objectional gas leakage, should pass through a packing gland or some other type seal, as shown schematically in Fig. 10. A particle detector, such as a filter or light scattering photometer also is shown.

The system should contain a valve, preferably downstream of the detector, to control the rate of sample flow. The sample should be metered before being returned to the pipeline or discharged to the atmosphere.

The sample may be moved through the system by one of three mechanisms — a pressure pump, discharge of the sample to a line at lower pressure or exhaustion of the sample into the atmosphere.

Two additional mechanical features are required when sampling high-pressure lines. These are ajacking device for forcing the probe into the line and a mechanical stop on the probe. This stop should be inside the pipe, so that pressure cannot force the probe out through the packing gland in the event that the jacking device should slip. The jack should also be equipped with a lock to fix the probe in position once it has been located at the desired point in the line.

Sampling Point Location

The ideal location for a sampling point is along a straight line of pipe where the gas is flowing undisturbed. The point should not be located after any bends or line restrictions, unless it is specifically desired to determine their role in the dust level of the gas. It will be recalled that bends or line restrictions cause disturbances in the gas flow and could cause either the loss or generation of particles that are not actually present in the straight line.

Heavy particles can be lost at a bend by impaction, and a sample taken downstream of a bend would show no heavy particles. A restriction, on the other hand, causes a pressure drop in the line, which produces a cooling effect and may result in condensation. This would introduce spurious particles that are not present in the gas stream ahead of the restriction.

Sampling Point Configuration

Most desirable method of sampling is to remove the sample in such a way that it flows in the same direction as the gas stream without passing through any turns in the sampling line. This may be accomplished by removing the sample with a straight probe at a bend in the line, as shown in Fig. 11-a. This is the preferred configuration since the sample is not re-

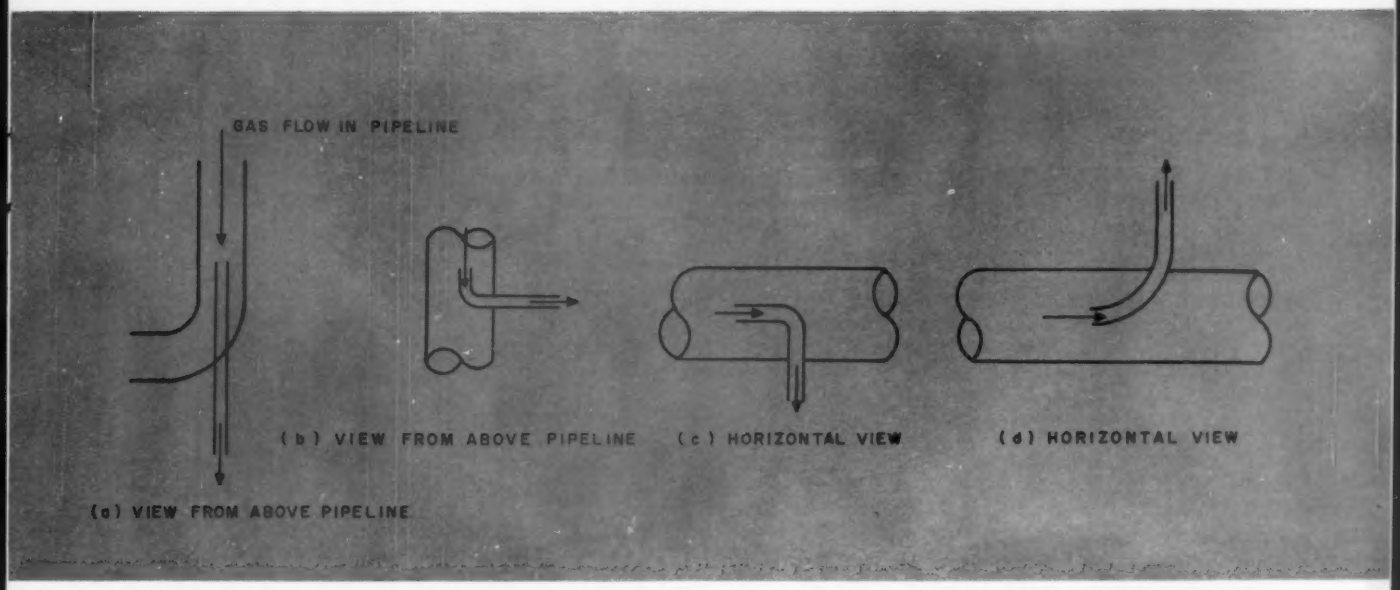

FIG. 11. Sampling point configurations.

by Arnold W. Doyle, Norman M. Wiederhorn, Arthur Swan

quired to pass through a turn in the sampling system prior to collection.

The probe should be long enough to project about 10 pipe diameters ahead of the bend, so that local disturbances surrounding the bend will be avoided. This configuration becomes unwieldy for large diameter pipes, for which a 30-ft probe might be necessary. In such cases, this restriction must be ignored, or a sampling point that withdraws at right angles to the gas stream may be employed, as illustrated in Fig. 11-b, 11-c and 11-d.

In Fig. 11-b the sampling probe is located horizontally. The point must therefore be on the side of the pipe. The advantage of this configuration is that the terminal settling velocities of particles need not be considered, since there are no vertical sections where they might be lost.

There is, of course, the problem of settling losses in the horizontal line. In general, this is more serious than settling in a vertical section and every attempt should be made to minimize this error by keeping the horizontal probe as short as possible.

Fig. 11-c and 11-d represent sampling points that use a vertical sampling probe. In one case, however, the probe is situated below the pipe; in the other, above the pipe.

Sampling from below is preferable for two reasons: (1) any impaction losses at the bend in the sampling nozzle would very likely be partially eliminated; and (2) the problem of maintaining sufficient flow to support particles of all sizes so that there will not be losses in the vertical line is avoided, since the gas flow and the particle settling velocities occur in the same direction.

It is realized that in general it will not be convenient to sample with the gas sampling point at the bottom of the pipeline and that frequently the configuration shown in 11-d or 11-b must be used; that is, either horizontal or vertical right-angle sampling. If a choice of these two configurations is available, 11-d is to be preferred.

The Sampling Probe

A suitable sampling probe must be of sufficient strength to withstand the pressure difference between the atmosphere and the pressure in the line. Preferably, its walls should be smooth both inside and out. Internal smoothness will minimize adherence of the particles in the stream to the wall. If a packing gland arrangement is to be used, a smooth exterior wall is desirable to achieve a satisfactory gas seal.

Internal diameter of the probe should be not less than 0.25-in. and preferably greater than 0.40-in. Every effort should be made to main-

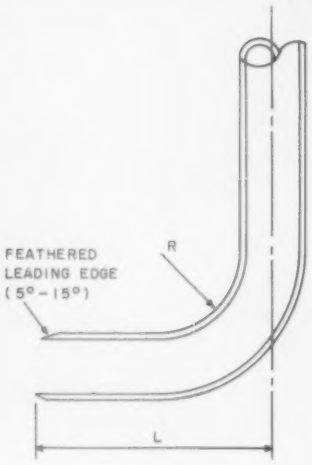

FIG. 12. Recommended sampling nozzle.

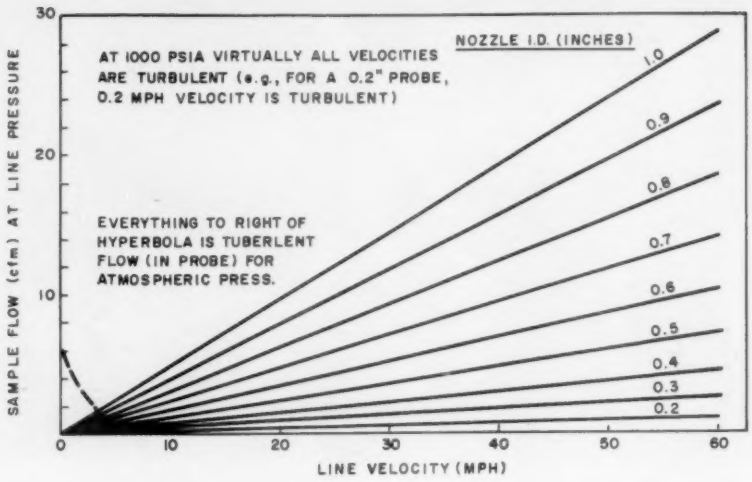

FIG. 13. Volume of flow necessary for isokinetic sampling.

tain a constant internal diameter from the tip of the sampling nozzle to the particle detector. If this condition does not exist, spurious liquid particles may be introduced by slight expansions or compressions of the sample.

The probe should also be as short as possible in order to minimize the settling losses in horizontal runs. Temperature changes of the gas in the probe must be minimized. The latter is quite important, for if the temperature of the probe is not kept as close as possible to the temperature of the gas stream, liquid particles may be vaporized or condensed in the probe and the sample will be in error with respect to such particles.

The probe should contain a minimum number of bends, and preferably none. When designing a sampling probe using a filter, one should remember to locate the filter so that particles will not fall from its face back into the gas stream. This may require one extra bend in the sampling probe line, so that the filter can be laid on its side. A more satisfactory arrangement, of course, would be to use a vertical downward sampling point, so that the filter is oriented properly without any additional bends.

The Sampling Nozzle

As mentioned above, the sampling nozzle should have the same diameter as the probe. The nozzle dictates, however, what this diameter should be. It is suggested that the diameter never be reduced to less than 0.25-in. and preferably should be greater than 0.40-in. It has been found that, even when sampling isokinetically, an improper sample is drawn if the nozzle diameter is reduced below a critical value. If the diameter is greater than 0.40-in. and sampling is isokinetic, a proper sample should be drawn into the nozzle. A sketch of a sampling nozzle is given in Fig. 12.

The leading edge of the nozzle should be feathered to minimize turbulent effects. The feathering should be done from the outside in order to preserve a constant internal diameter. The angle of feathering is preferably 5 deg; however, 15 deg is acceptable, provided the wall thickness of the probe is not excessive. It has been postulated by Watson and Griffith and Jones that the reason for the sampling errors for small diameter nozzles is the bluffness of the probe.

A measure of bluffness is the ratio of the area of the wall of the nozzle to the area of the aperture of the nozzle. Values from 0.35 to 1.25 have been used without this effect being noticeable. It is recommended, however, that the ratio be less than 1.0 whenever possible. The radius of curvature of the inside of the bend (R) should be equal to, or greater than, 0.5-in.

It is realized that short curvatures are often necessary to permit the entrance of the nozzle through a valve and into the pipe. If curvatures less than 0.5 in. are used, however, impaction

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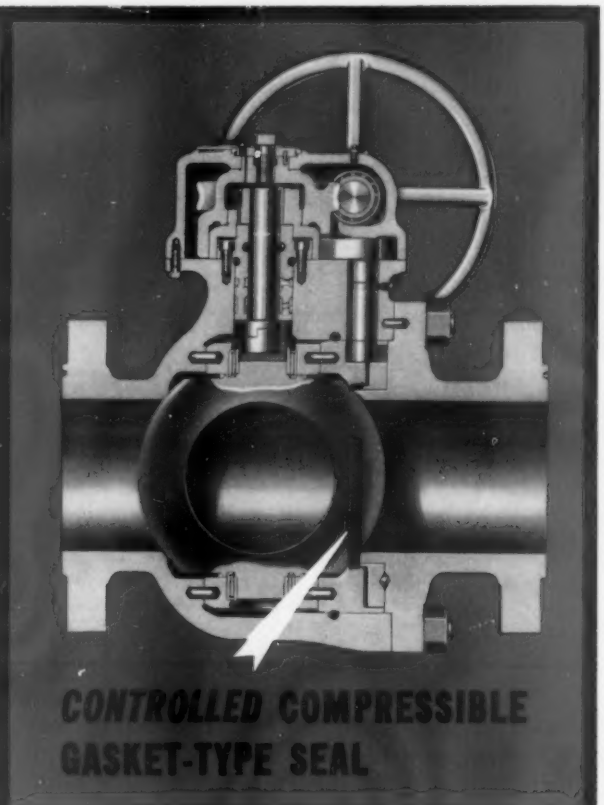

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Summary of Sampling Errors

Source of Sampling Error	Type of Error Introduced	Particle Size Concerned	Importance of Effect	Action for Best Sampling
1. Flow at nozzle entrance	a. Too high an indicated concentration when the sample is drawn at a rate less than isokinetic.	Large	Very	Sample isokinetically.
	b. Too low an indicated concentration when the sample is drawn at a rate higher than isokinetic.	Large	Very	Sample isokinetically.
2. Bends in the sampling piping	Loss of particles due to impaction at the wall.	Most serious with large	Very	No bends in sampling system. (Sample at an elbow.) Sample at low velocity.
3. Brownian motion	Loss of particles due to impaction at the wall.	Small	Slight	Minimize length of sampling system.
4. Turbulent impaction	Loss of particles due to impaction at the wall.	All	Unknown	Sample so that the sample flow is streamlined whenever possible.
5. Settling	a. Loss of particles in vertical sections of piping.	Large	Slight	Eliminate vertical piping from sampling system.
	b. Loss of particles in horizontal sections of piping.	Large	Very	Keep flow in sampling tube turbulent or minimize length of horizontal sampling tube.
6. Condensation or evaporation	a. Increase or decrease of liquid suspensoid concentration caused by adiabatic expansion or compression of the sample.	All (Liquid Particles)	Very	Eliminate regions of sample expansion or compression from the sample piping. Use minimum length of smooth wall tubing. Have no flaring out or tapering in of the nozzle entrance.
	b. Increase or decrease of liquid suspensoid concentration by heating or cooling the sample.	All (Liquid Particles)	Very	Do not heat or cool the sample.
7. Diameter of sampling nozzle	Indicated concentration of suspensoids too low.	Large	Very	Keep nozzle greater than 0.3-0.4-in. ID
8. Probe direction	Indicated concentration too low when poorly directed.	Large	Very	Point nozzle upstream at all times.
9. Probe location in duct	If stratification of suspensoids occurs in the duct, samples taken at various points will yield different results.	All	Nil if flow is turbulent.	Traverse the line if flow is streamlined; otherwise, sample at any point away from the extremes of the pipe.

losses at the sharp bend may be excessive. Whenever possible, it would be desirable to increase the radius of curvature to 2 or 3-in.

Sampling Procedure

Samples should be drawn isokinetically. Fig. 13 shows the probe flow necessary for isokinetic sampling with various size nozzles; the sampling volume in cubic feet per minute is plotted against the line velocity in miles per hour. Once the line velocity is known, this chart may be used to select a convenient volumetric sampling rate and nozzle diameter. The sampling nozzle size and isokinetic flow requirements specify the volumetric rate of flow.

Fig. 5 (in Part 3-A, Pipeline Engineer, August, 1961) shows the expected loss by impaction at a bend for various volumetric rates of flow in sampling nozzles of different sizes. This figure should be consulted also before choosing the volumetric rate of sample withdrawal, so that impaction losses will not be greater than is necessary.

Finally, the probe should face into the gas stream at all times.

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Arnold W. Doyle, Norman M. Wiederhorn, Arthur Swan, Arthur D. Little, Inc., Cambridge, Mass.

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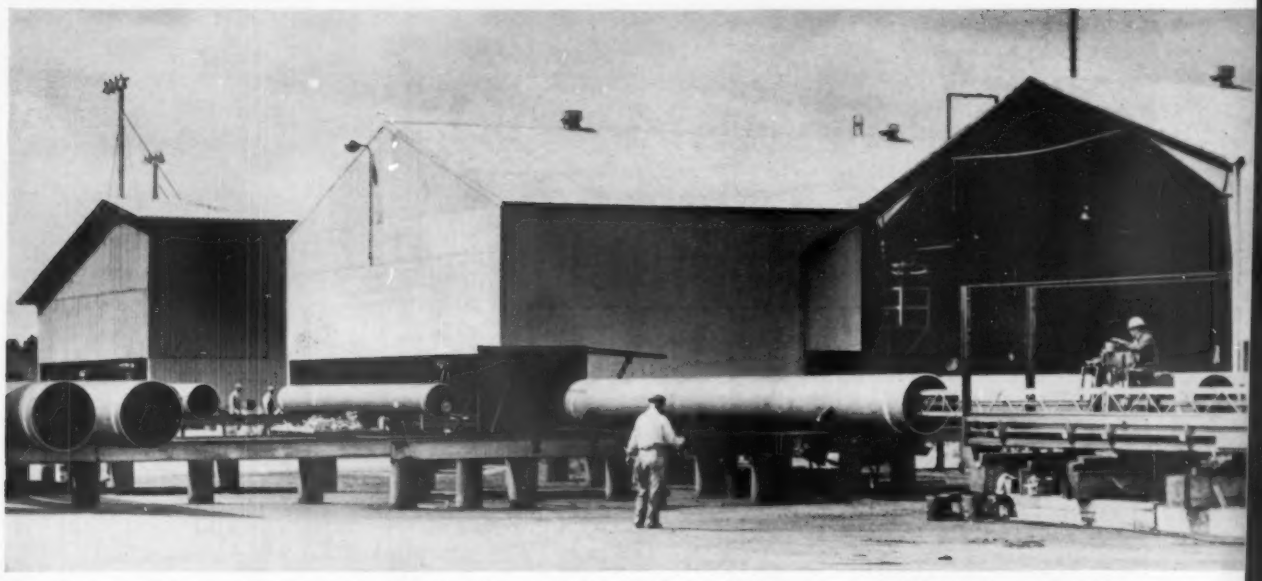


Overall view of internal pipe coating plant at Napa, Calif. Fork trucks remove coated joints from machine.

Giant Gas Line Is Production-Line Coated

To increase gas throughput, a corrosion-resistant epoxy coating lines two-thirds of the new Alberta-California pipeline's southern section.

Pacific Gas & Electric Co. specified the internal coating to permit up to 6% increase in pipeline flow efficiency, cleaner gas and reduced maintenance costs. The epoxy coating then was applied automatically on a production-line basis to more than 160 miles of 40-ft pipe joints at Kaiser Steel Corp.'s Napa, Calif., fabricating division.

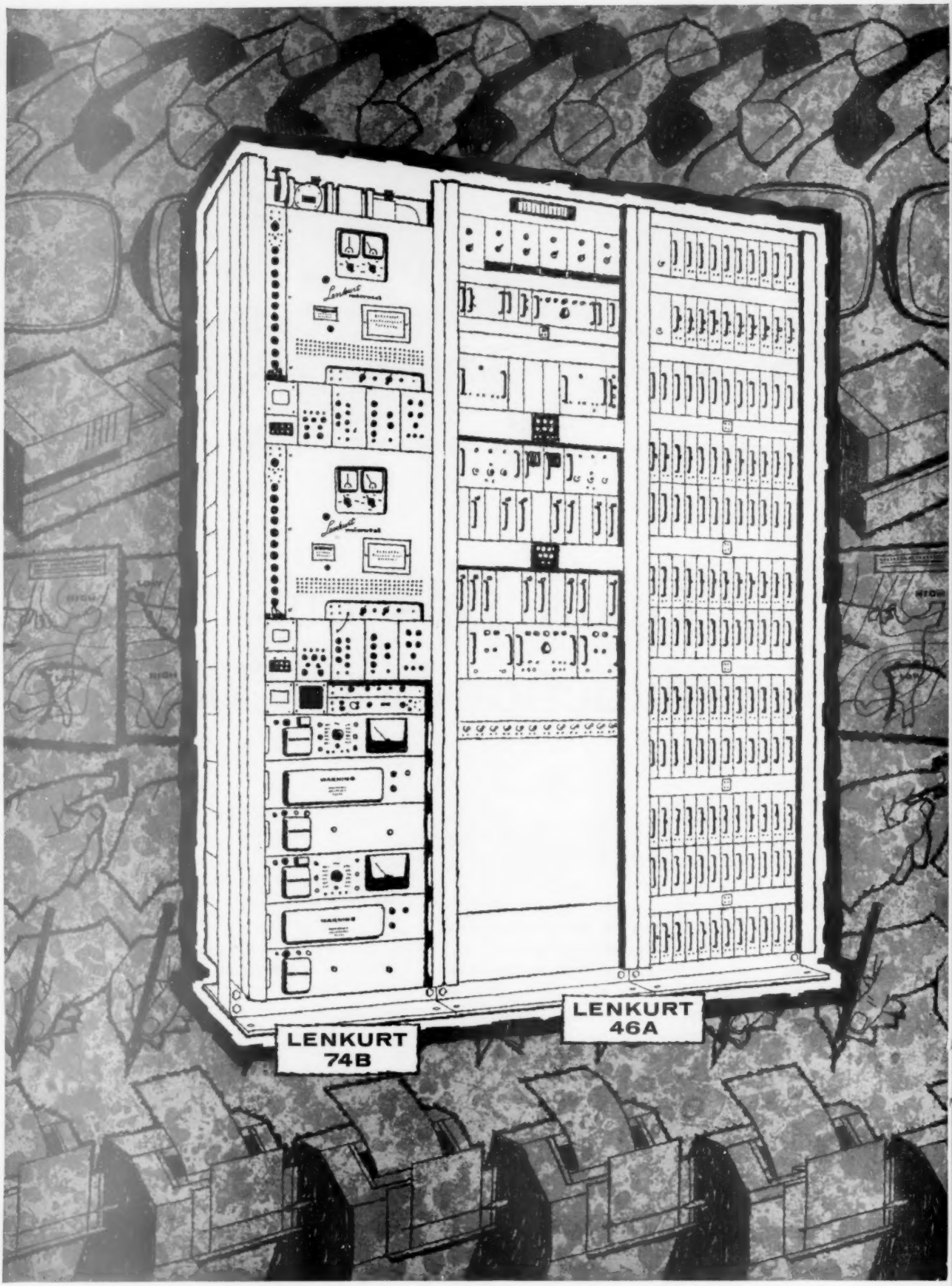
One of the largest gas transmission lines in the world, the Alberta-California extends from gas fields northwest of Edmonton, Alta., Canada, to Antioch, Calif., in the San Francisco Bay area. Most of it is 36-in. in diam. Its initial deliveries to California will average 415,000,000 cu ft per day.

Friction Reduced

By reducing friction, the smooth, tough, glossy finish reduces the load on gas scrubbers and cuts down the compressor power needed to move the gas. Walls of epoxy-coated pipe have an average relative roughness of only 280 microinches, compared with an average of over 700 microinches in unweathered mill pipe. Within 60 days, uncoated weathered pipe can develop a surface roughness up to 1500 microinches, amounting to about a 2½% loss in efficiency of gas transmission.

At Napa, Kaiser produced the X-52 grade pipe in 40-ft lengths from 7/16-in. thick steel plate manufactured by its Fontana, Calif., mill. Twenty-three miles of pipe were turned out monthly.

In a preformer, the plate was trimmed, chamfered, beveled and shaped into rough roll form. This was followed by forming in "U-ing" and "O-ing" presses. After the pipe was band-clamped, the seam was manually tack-welded every 3 in. Ends were squared off and the pipe was de-greased, washed and dried. Run-off tabs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The 46A, which is expandable to 600 channels, uses solid-state devices throughout, and is the result of many years' research and development by Lenkurt Electric. It has been engineered to meet the exacting requirements of high data loading, high-density voice communications, and CCITT specifications.

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For detailed information on the 46A and 74B, complete the coupon below and mail to: Department 216, Lenkurt Electric Co., Inc., San Carlos, California.

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were then welded to the ends. The pipe seam was internally and externally welded by the submerged-arc process.

The welded length of pipe (35⅝-in. OD) was hydraulically expanded to a perfect 36-in. OD circle in an operation that simultaneously straightened the pipe and subsequently hydrostatically tested it. All pipe seams were magnaglow-tested for a length of 12 in. at each end to determine weld soundness. Final step before coating was beveling the ends for double-jointing.

Coating Line Set-Up

To speed delivery of the pipe, fabrication was integrated with an independent internal pipe coating line set-up at the terminus of Kaiser's production facilities by the L. C. Russell Co., Beaumont, Tex. This company was the painting contractor for PG&E.

Hourly, a conveyor delivered 22 joints of pipe to the spray line. A joint to be coated was rolled automatically into position and clamped.

The coating line consists of a 65-ft electrically-operated machine that can spray-coat steel joints from 26 to 42-in. diam. Rotating spray and brush heads are attached to a boom that rolls inside the joint. On the entry pass, 48 steel scratch brushes are expanded to contact the walls and remove mill scale, dirt and other contaminants. Brushes are changed at each 8-hr shift.

Four air guns behind the brushes simultaneously blow the debris from the joint. Thorough cleaning takes just 23 sec. Occasional grease and oil spots, which could impair adhesion of the coating, are removed with solvent before brushing. Emerging from the other end of the pipe, the brush head is retracted and air pressure turned off prior to spraying.

Air-drying Epoxycote pipe coating is produced by Napko Corp., Houston, Tex.

The coating (based on the Shell Chemical Co.'s Epon resins) is prepared by mixing 3 gal of resin component, 1 gal of amine curing agent component and 1 gal of reducer. One gallon of the coating covered the interior of a joint to a 2-mil dry thickness. Approximately 20,000 gal of coating were required for the 160 miles of pipe.

Coating Preparation

The mixture is prepared as needed, poured into a 30-gal pot and pumped through a ½-in. galvanized pipe to five automatic spray guns. At the end of each day, solvent is blown through the lines and spray guns to clear them for the following day's run.

Guns, except for nozzles, are covered with two cloth "socks" to minimize overspray inside the joint. Socks are changed after every 25 joints to prevent slinging of solid chunks of paint.

Spray head is rotated at 175 rpm, as the boom is baked into the pipe. Guns are spaced approximately 1 ft from the walls. A baffle plate supports the head and eliminates paint overlap. Spraying is completed in 23 sec.

Spray pressure and rate of boom travel are calculated to deposit a minimum 5-mil wet coating. Joints are recoated if the thickness is less. The coating dries to a 2-mil thickness, which is adequate to prevent internal corrosion and provide good resistance to abrasion. The finished surface is essentially free of pinholes, sags, fisheyes, orange peeling and other film irregularities.

Cured In 24 Hours

At an ambient temperature of 70-75 F, the coating dries for handling in 1 to 2 hr, develops good strength after 8 hr and cures completely in 24 hr. At 50 F the pot life of the coating is such that it will remain sprayable for a minimum of 8 hr and a maximum of several days. In rainy weather or on days of high humidity, sprayed joints are capped at both ends with polyethylene sheeting to reduce possibility of damage by premature exposure to water.

After the joint has been coated, the beveled edges and a ½-in. width inside both ends are wiped with methyl ethyl ketone to ensure bare metal surfaces for subsequent joint welding. The coating is finally inspected for continuity with a low-voltage moisture penetration instrument.

The joints are stacked in the field and, after 24 hr, welded into 80-ft lengths.

Approximately 175 miles of coated pipe for the California section was double-jointed at Napa and at Burney, Calif., by H. C. Price Co. before being shipped to the various installation sites.

The southernmost 90 miles of Kaiser-produced pipe will not require internal coating. These final miles in the Sacramento Valley are essentially a "pack-and-draft" section. PG&E felt that application of internal coating was not warranted because of the intermittent flow characteristics of the line there. ■

Coming Construction

Products Line To Be Built

Humble Pipe Line Co. plans to expand its products pipeline system in Texas with 270 miles of 6, 8 and 10-in. Beginning near the Baytown refinery area, the pipeline will serve the San Antonio and Austin areas and intermediate points along the route.

Initial capacity of the system will be 17,000 bpd. Plans include three remotely-controlled pumping stations and provisions for increasing capacity, when necessary, by additional pumping facilities at any of the three stations or by construction of intermediate stations.

The 8 and 10-in. lines will extend westerly out of Baytown for about 177 miles. From this point, two 6-in. extensions will be laid—one approximately 43 miles to Austin, and one approximately 50 miles to San Antonio.

Construction will begin immediately, with completion scheduled for early 1962.

175-Mile Gas Line Planned

Bi-Stone Fuel Co. of Corsicana, Tex., has started surveying right-of-way for a 175-mile gas pipeline to serve Texas Power & Light Co. generating plants in North and Northeast Texas.

The planned system includes: 100 miles of 16-in. from Bethel, West Anderson County, to Merit in Hunt County, then 30 miles of 10-in. northward to a new TP&L plant under construction at Savoy, Fannin County; and 30 miles of 10-in. from Merit to serve McKinney and Denton area power plants.

The company is reported to have contracted with Texaco Inc. for its Bethel Dome field gas and with Sanders & Murchison for its Tri-Cities field gas.

Tex-Florida Expansion Ok'd

Houston Texas Gas and Oil Corp. and Coastal Transmission Corp. have been granted permission to expand their Texas-Florida pipeline system with 300 miles of lateral lines and seven new compressor stations.

Under Federal Power Commission authorization, Houston Texas will build about 235 miles of sales laterals and 30,000 hp compressor capacity at an estimated cost of $16,126,000. Coastal will construct 71 miles of supply laterals and 12,500 hp on its system at an estimated cost of $7,275,000.

Expansion will increase pipeline capacity by approximately 100,000,000 cu ft of gas per day for deliveries to the Florida market.

Pipeline investment will be increased only 13½%, while system capacity will be increased 35%, according to The Houston Corp., parent company.

Completion of the expansion is scheduled for March 1962.

Starts 257-Mile Project

Natural Gas Pipeline Co. of America has received authority from the Federal Power Commission to construct 257 miles of pipeline and two compressor engines totaling 5800 hp. Construction, which will increase the firm's daily delivery capacity by an additional 63,000,000 cu ft, was started immediately upon acceptance of the certificate.

The firm also has under construction 91 miles of pipeline and the supercharging of 73 main line compressor engines. This latter 105,000,000-cu-ft project was approved earlier this year.

Cost of the two projects is estimated at $52,500,000.

Trans-Canada Adds HP

Trans-Canada Pipe Lines Ltd. is expanding capacity of its main natural gas transmission line with installation of seven new compressor units. Stations and their new and total installed capacities are:

Cabri, Sask.	9,660	19,129
Herbert, Sask.	9,580	18,980
Regina, Sask.	9,770	19,348
Grenfell, Sask.	9,680	19,360
Portage, Man.	10,070	20,140
Ile des Chenes, Man.	2,500	10,000
Port Arthur, Ont.	2,500	10,000

The larger units are turbine compressors driven by line fuel.

Transco Gets "Temporaries"

Transcontinental Gas Pipe Line Corp. has received temporary authority from the Federal Power Commission on two proposals totaling $34,629,350.

One involves 187 miles of 36-in. loops in Louisiana, Mississippi, Alabama, Georgia, South Carolina, North Carolina, Virginia and Maryland, and a 4000-hp compressor station in Louisiana.

The other involves a new 4200-hp station and 17 miles of line connecting Block 23 in the South Marsh area, offshore Louisiana, with Transco's system. This is part of a proposed larger project designed to increase Transco's supplies to existing customers, particularly during the winter heating season.

Plans Loop In Alberta

Texaco Exploration Co. has filed application for permission to lay an 8-in. loop of its 50-mile crude oil pipeline from Rimbey field in the west central area of Alberta to its Edmonton refinery.

No estimate of cost was given. It was explained that the additional line capacity will be allocated partly to movement of condensate that will become available soon from wet gas processing.

Short Crude Line Planned

A $2,000,000 submerged pipeline and related facilities will be built by Standard Oil Co. of California, it is reported.

The 2-mile pipeline, to be built at the El Segundo, Calif., refinery operated by a subsidiary, Western Operations, Inc., is scheduled for January completion.

Construction will include an onshore tank with a capacity of 323,000 bbl and a pump station.

To Replace Sections

The Federal Power Commission has accepted for filing an application by The Ohio Fuel Gas Co. seeking authority to increase its pipeline capacity with several replacements.

The firm would replace: 5.7 miles of 12-in. with 20-in. in the Grafton-Berea-Parma area of Lorain and

Cuyahoga counties, Ohio; 8.4 miles of 8-in. with 12-in. in the Alliance-Waynesburg area of Wayne, Stark and Carroll counties; and 4.5 miles of 8-in. with 12-in. in the Crawford-Zanesville area of Perry and Muskingum counties.

Penn Work Given "Temporary"

The Manufacturers Light and Heat Co. has been granted temporary authorization by the Federal Power Commission to construct 10½ miles of 24-in. to replace sections of an existing 16-in. in Allegheny, Washington and Beaver counties, Pa., and to add 4000 hp at an existing compressor station in Marshall County, W. Va.

With the new facilities, estimated to cost $2,387,000, the company can take additional natural gas from its Victory storage field in Marshall and Wetzel counties, Pa.

$1,523,000 Facilities Ok'd

El Paso Natural Gas Co. has received Federal Power Commission authorization to increase capacity of its Eunice field compressor station in Lea County, N. M., by 3400 hp and to build about 9 miles of 12-in. field line with metering facilities in Lea County.

Internationally...

The Soviet minister of foreign trade has announced in London that Russia is prepared to build an oil pipeline from Irkutsk in Siberia to the Pacific Ocean. Construction, he said, depends on continued growth of oil purchases by Japan.

In Libya, construction of a pipeline spur into the Mabruk oil field has been postponed by Texas Gulf Producing Co. pending completion of engineering studies to evaluate the field's secondary recovery possibilities.

In Karlsruhe, Germany, Rhein-Donau-Oelleitung (RDO) G.m.b.H. has been formed to construct the proposed Karlsruhe-Ingolstadt pipeline.

FPC Filings

Arkansas Louisiana Gas Co., Shreveport, La., CP 62-40, filed Aug. 17, 1961. *Construction:* facilities necessary to sell and deliver from Major County, Okla., leases to Oklahoma Natural Gas Gathering Corp.

Cost: applicant has borne its share ($12,200) of cost of well facilities in presently producing units (both near Fairview, Major County), and, since it owns 50% or less interest in the two presently completed wells from which gas will be delivered, no further details of cost are included.

Atlantic Seaboard Corp., Charleston, W. Va., CP 62-43, filed Aug. 22, 1961. *Construction:* 40.3 miles of 30-in. from Loudon County, Va., to Howard County, Md., and the turbocharging of six existing compressor units to 1320 hp each at Lost River station, Hardy County, W. Va.

Cost: $5,476,000 which includes: $1,308,000 for installation and materials in Virginia; $3,803,000 for installation and materials in Maryland; and $365,000 for additional horsepower.

Cities Service Gas Co., Oklahoma City, Okla., CP 62-36, filed Aug. 14, 1961. *Construction:* tap on existing 16-in., plus meter setting and regulator equipment, in Rice County, Kan., near Alden, for sale to Gas Service Corp.

Cost: $3400 which includes: material, $2200; labor, $700; transportation, $200; engineering, supervision, $150; warehouse, insurance, $150.

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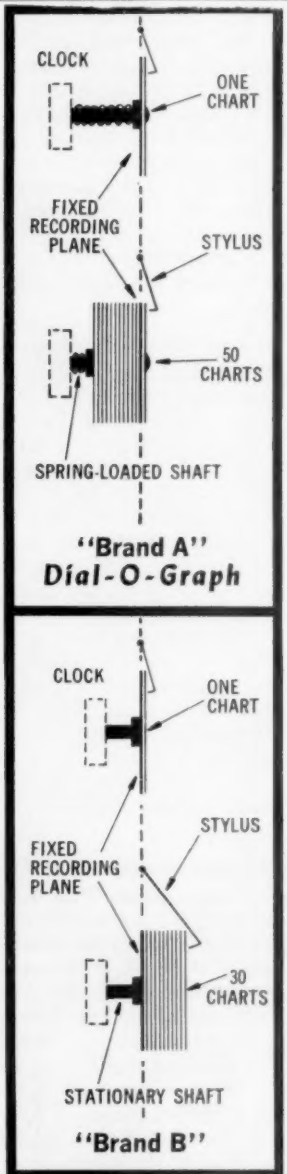

Diagrams illustrate how a stack of charts can affect the accuracy of the recording stylus.

North Central Gas Co., Casper, Wyo., CP 62-38, filed Aug. 17, 1961. *Construction:* connecting and metering facilities near Orin, Platte County, Wyo., to receive residual gas from Tower Oil and Gas Co. and exchange with Kansas-Nebraska Natural Gas Co. Inc. (part of a two-stage, long-range natural gas supply and development plan).

Cost: $2112 which includes: orifice fitting and tube, $429; orifice meter, $277; recording thermometer, $231; three 4-in. valves, $231.50; six 4-in. flanges, $48.25; 48 steel studs, $22.75; six 4-in. weld ells and miscellaneous fittings, $27.50; labor, $195; meter house, $335; erection of meter house, $265.

The Manufacturers Light and Heat Co., Pittsburgh, Pa., CP 62-50, filed Aug. 23, 1961. *Abandonment:* 85-hp Dexter compressor station, Porter Township, Clarion County, Pa., at a cost of $1500; 1000-hp unit at Hundred station, Church district, Wetzel County, W. Va., at a cost of $1700; 2280-hp Sedalia station in McClellan district, Doddridge County, W. Va., at a cost of $12,500; about 15 miles of 10-in. line in West Union, Grant and McClellan districts and 2.2 miles of 16-in. in Greene district, Wetzel County, W. Va., at a cost of $2000; and two sections of 6-in. in Pennsylvania at a cost of $1300.

Mississippi River Transmission Corp., St. Louis, Mo., CP 62-48, filed Aug. 18, 1961. *Construction:* 1.9 miles of 4½-in. delivery line and metering and regulating facilities in St. Louis County, Mo.

Cost: $63,000 which includes: connections and line pipe, $21,750; meter tubes, valves, regulators, pipe, instruments, $7250; contingencies, $2875; right-of-way and easements, $9500; installation, $18,750; engineering, supervision, general overhead, $1725; interest, $1150.

Northern Natural Gas Co., Omaha, Neb., CP 62-37, filed Aug. 15, 1961. *Construction:* "budget" facilities to transport and receive into its main line gas from new producing areas in the Permian Basin in Texas, near Oklahoma border.

Cost: $3,000,000 maximum, with no single project exceeding $500,000 for a one-year period.

CP 62-47, filed Aug. 23, 1961. *Construction:* measuring and regulating stations for new delivery points (abbreviated application, request for blanket authority).

Cost: $200,000 total, with each point not to exceed $18,000.

New York State Natural Gas Corp., Pittsburgh, Pa., CP 62-49, filed Aug. 23, 1961, jointly with Texas Eastern Transmission Corp., Houston, Tex. *Construction:* 7.1 miles of 6-in. from four existing wells in Monroe Township, Bedford County, Pa., and a measuring station at point of interconnection with Texas Eastern's 20 and 24-in. lines near Rock Hill Church.

Cost: $155,694 which includes: pipeline construction, $73,295; materials, $60,944; right-of-way and damages, $13,620; engineering and supervision, $4500; and measuring station, $3335.

Trunkline Gas Co., Houston, Tex., CP 62-41, filed Aug. 17, 1961. *Construction:* 491 ft of 4½-in. OD pipe and measuring station in Hidalgo County, Tex., near U. S.-Mexico border for short term sale of gas to Texas Eastern Transmission Corp. on interruptible basis.

Cost: $15,000 which includes $5000 for pipeline (labor, materials and right-of-way) and $10,000 for dual 4-in. measuring station (complete).

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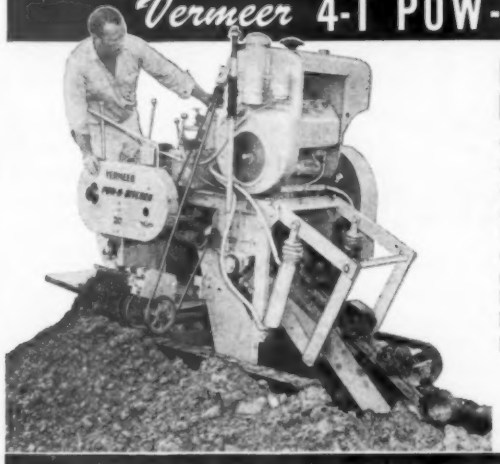

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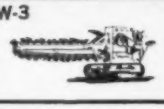
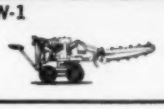
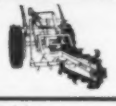
W-3 

W-1 

3P 

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Pipeline Contractors

Banister Construction Co., Ltd., Box 2408, Edmonton, Alta., Canada. *Peace River Oil Pipe Line Co., Ltd.* — 177-mile, 8 and 12-in. from Fox Creek pumping station in north central Alberta to Edmonton. Superintendent: Jack Engelking. Field office: Whitecourt.

Brodie Construction Co., Box 2646, Amarillo, Texas. *Northern Natural Gas Co.* — 176 miles of 2 through 8-in. in Iowa.

O. R. Burden Construction Corp., Box 5216, Tulsa, Okla. *Alamo Gas Supply Co.*—291 miles of 14 through 24-in. in southwest Texas to supply gas to San Antonio.

Dixie Pipe Line Co.—Griffin, Ga., to McBee, S.C., portion of 1100-mile, 6, 8, 10 and 12-in. LPG line.

Service Pipe Line Co. — 70 miles of 4, 6 and 8-in. near Labarge, Wyo.

Texas Eastman Co.—117 miles of 6-in. from Longview to Trinity, Tex.

Canadian Bechtel, Ltd., 25 King St., W., Toronto 1, Ont., Canada. *Western Pacific Products and Crude Oil Pipelines, Ltd.* — 145 miles of 12-in. in British Columbia from Taylor to Pine Pass.

Davis Construction Co., 709 N. Broadway, Cleveland, Okla. *Northern Natural Gas Co.* — 116 miles of 2 through 8-in. in Minnesota.

Dutton-Williams Bros., Ltd., North Canadian Oil Bldg., Calgary, Alta., Canada. *Western Pacific Products and Crude Oil Pipelines, Ltd.*— 360 miles of 12-in. in British Columbia from Prince George to Kamloops, under supervision of Harland Evens and E. Maddoms.

Fowler-Tatom, Pipeline Contractor Inc., Box 368, Cotton Valley, La. *Seadrift Pipe Line Co.* — 121 miles of 6-in. from Brownsville to Kingsville, Tex., under the supervision of R. G. Kemper. Field office: Riviera, Tex. Office manager: W. G. Barnette.

R. H. Fulton & Co., Box 1526, Lubbock, Tex. *Continental Pipe Line Co.* — 550 miles of 2, 3, 4, 6 and 8-in. in Montana and Wyoming.

Northern Natural Gas Co. — 87 miles of 24 and 30-in. loops from near Beaver, Okla., to near Albert Lea, Minn.; 60 miles of 26-in. east of Ogden, Iowa; and 64 miles of 26-in. east of Waterloo, Iowa. Also, 82½ miles of 20-in. in Joe Daviess County, Ill., and in Grant, Lafayette, Green, Rock and Walworth counties, Wis.

Sinclair Pipe Line Co.—170 miles of 8-in. from LaVerne to near Newalla, Okla.

Anadarko Production Co. — 83 miles of 10 and 12-in. in Kingman, Sedgwick and Butler counties, Kan.

Natural Gas Pipeline Co. of America — 27 miles of 30-in. loop in Livingston and McLean counties, Ill., and 62 miles of 36-in. loop in Meade, Clark, Ford, Republic and Cloud counties, Kan., and Mahaska County, Iowa.

Hall Construction Co., 1105 N. Carlton, Liberal, Kan. *Panhandle Eastern Pipe Line Co.*—a 330-mile, 4 through 12-in. gathering system in western Kansas. Supervising are Mike Bell and M. E. Banning.

Harbert Construction Corp., Drawer 75, Birmingham, Ala. *Northern Natural Gas Co.* — 138 miles of 2 through 8-in. lateral lines in Minnesota. Field office: Pine Island. Superintendent: Jay Cundiff.

Henuset Brothers, Ltd., Box 657, Virden, Man., Canada. *The Alberta Gas Trunk Line Co., Ltd.* — four laterals totaling 58 miles as follows: 6.8 miles of 16-in. from Wildcat Hills field to main line near Cochrane west of Calgary; 24.3 miles of 22-in. from East Calgary field to main line near Cochrane; 14.5 miles of 16-in. from Carstairs processing plant near Carstairs and Crossfield fields to foothills system main line west of Crossfield; and 12.5 miles of 12-in. from Minnehik-Buck Lake field to southwest of Buck Lake on foothills system main line.

Houston Contracting Co., 2807 Buffalo Speedway, Houston 6, Tex.

Texas Eastern Transmission Corp. — 161 miles of 20-in. from West Monroe, La., to Kosciusko, Miss.

Dixie Pipe Line Co. — 226 miles of 10-in. LPG from Mont Belvieu, Tex., to Baton Rouge, La.

Transcontinental Gas Pipe Line Corp. — four loops consisting of 65 miles of 30 and 36-in. from Fulshear, Tex., to New Roads, La., under the supervision of M. L. Thompson.

Texas Gas Transmission Corp. — approximately 70 miles of 26 and 30-in. loops from vicinity of Memphis, Tenn., to vicinity of Lafayette, La. Superintendent: A. J. Slovack. Assistant superintendent: L. L. Patterson. Office manager: B. C. Sweeney. Also, 52 miles of 8, 16 and 20-in. from near Bay Round in the Louisiana marsh to near Morgan City, La. Superintendent is R. E. Thornton, and field office manager is S. B. Harrison.

C. S. LeNoir Construction Co., Box 798, Austin, Tex. *Transcontinental Gas Pipe Line Corp.* — 83 miles of 36-in. in four loops: 21 miles in Walthall, Marion and Jefferson Davis counties, Miss.; 12 miles in Choctaw County, Ala.; 32 miles in Perry and Dallas counties, Ala.; 18 miles in Autauga and Chilton counties, Ala. Superintendent: W. B. Williams. Field office manager: R. E McManus.

Majestic Contractors, Inc., subsidiary of Majestic Contractors, Ltd. *Montana Power Co.* — 56 miles of 16-in. from Cut Bank, Mont., headquarters, to the Canadian border near Carway, Alta.

Majestic Contractors Ltd., 49 Jackes Ave., Toronto 7, Ont., Canada. *Westcoast Transmission Co. Ltd.* — 40 miles of small diameter natural gas gathering lines in Northeast British Columbia.

Mannix Co., Ltd., 737 — 3 Ave., S.W., Calgary, Alta., Canada. *Alberta Gas Trunk Line Co., Ltd.* — compressor station at Princess, Alta., under the supervision of J. Hobbs.

Midwestern Contractors Inc., 130 W. Liberty Dr., Wheaton, Ill. *West Shore Pipe Line Co.* — Hammond station in Lake County, Ill., Blue Island station and junction in Cook County, Ill., Bell station in Cook County, and Romeo station and Des Plaines terminal in Will County, Ill.

Panama, Inc., 1801 Tennessee Bldg., Houston 2, Tex. *Trunkline Gas Co.*—41 miles of 26-in. and 9 miles of 30-in. between Jennings and Longville, La.

United Gas Pipe Line Co. — 60 miles of 36-in. offshore Louisiana, 60 miles of 30-in. out of Breaux Bridge, La., and 60 miles of 30-in. out of West Monroe, La.

Panama-Williams Corp., 1418 Melrose Bldg., Houston, Tex. *Carolina Pipe Line Co.* — 87 miles of 8 and 10-in. from Aiken to Camden, S. C., under the supervision of Blackie Woodruff.

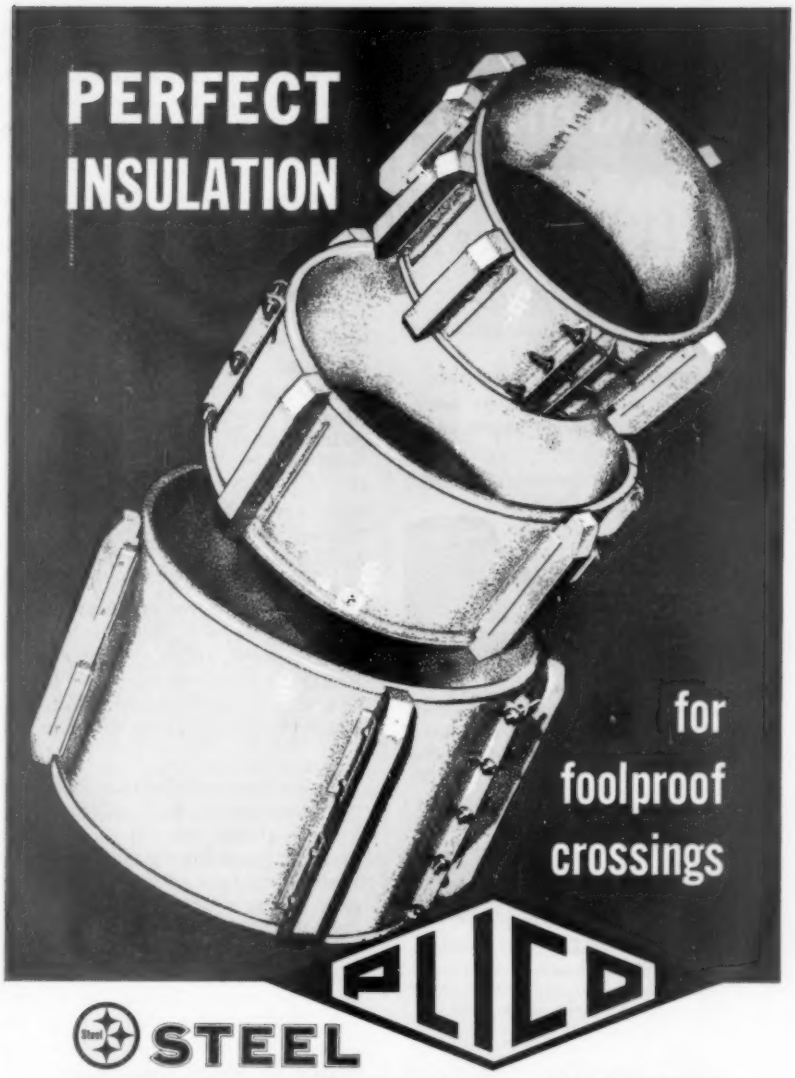
Natural Gas Pipe Line Co. of America — 73 miles of 30-in. loops in the areas of El Campo and Refugio, Tex., with field office at the former. W. N. Shiflett is superintendent. Also, 62 miles of 30-in. loops in the areas of Marshall and Cleveland, Tex., with field office at the former. M. E. Sutton is superintendent.

Pease Bros. Co., 120 E. Main St., Vernal, Utah. *Mountain Fuel Supply Co.* and *Utah Natural Gas Co.*—103 miles of 20-in. from the Uintah Basin to Clear Creek, Carbon County, Utah.

Pentzien, Inc., 1504 Dodge St., Omaha, Neb. *Dixie Pipe Line Co.* — single 12-in. crossing of Mississippi River near Baton Rouge, La. Superintendent: James R. Zeman.

Poling and Bacon Construction Co. Inc., 10400 South Avenue Extended, Youngstown 14, Ohio. *West Shore Pipe Line Co.* — Jones Island terminal in Milwaukee, Wis., and St. Martins junction also in Milwaukee County.

H. C. Price Co., Price Tower, Bartlesville, Okla. *Pacific Gas & Electric Co.* — 296 miles of 36-in.



STEEL

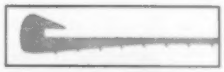
PIPELINE INSULATING SPACERS

You cannot afford not *to buy*

the strongest, safest insulating spacers ever produced!

RUGGED HEAVY DUTY STEEL BODY, hot dip galvanized and enameled the distinctive PLICO Yellow. Defies corrosion and abuse. Complete lines in 6, 8 or 12-in. body widths.

VIRGIN POLYETHYLENE LINER–no fillers–no "regenerated" scrap–beefed up in entire edge area to eliminate cuts or short-outs even if a spacer should cock as it is slid into the casing. Assures positive, permanent insulation.



FLINT-HARD MICARTA SKIDS shrug off abrasion and heaviest loads. Outstanding dielectric and mechanical qualities give unusual margin of safety.

Everything about PLICO **STEEL** Spacers–including hot dip galvanized fastenings–is top quality . . . yet they cost no more than so-called "economy" spacers. Why compromise? Why send a boy to do a man's job? CALL YOUR NEAREST PLICO DISTRIBUTOR OR WRITE US FOR FULL DATA AND PRICES.

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WELDING FITTINGS

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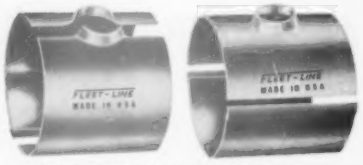
REDUCERS: Concentric and Eccentric, 1" through 30". ASA B16.9, ASTM A234. Schedules 10 to 160, X and XX heavy, stainless steel, chrome-moly and other alloys, genuine wrought iron, copper, aluminum. Special lengths and sizes without delay.

SADDLES, conventional, and for pressure vessel heads. Nozzle sizes from ¼" through 24" with skirts to any size. FLEET-LINE saddles weld neatly into place in much less time and with much less welding rod.



FULL-ENCIRCLEMENT SADDLES, nominal pipe sizes 2" through 36". Five types.

REDUCING TEES, Forged Steel, 8" through 30".

MADE IN U.S.A.

STEEL FORGINGS, Inc.

P. O. Box 276 A Shreveport, La.

to the Oregon border from the San Francisco Bay area. Superintendent: R. L. Ezell. Office manager: Bob Walker. Entire line is being Somastic coated by Price Co. pipe coating division.

Pacific Gas Transmission Co. — 146 miles of 36-in. from Rosalia, Wash., to the Idaho-British Columbia border. Superintendent: G. A. Reutzel. Office manager: E. Dickson at Veradale, Wash. Entire line being double-jointed and yard enamel coated by Price Co. pipe coating division.

El Paso Natural Gas Co. — 14.4 miles of 30-in. in Washington, beginning near Spokane and tying in with the Pacific Gas Transmission line currently under construction in that area. Superintendent: L. O. Reutzel. Field office manager: Allen Stotler at Veradale, Wash.

Texas Eastern Transmission Corp. — 26.5 miles of 30 and 36-in. in New Jersey. Superintendent: Elwood Roth. Office manager: Nick Beffer at Flemington, N. J. Entire line also being Somastic coated by Price Co. pipe coating division.

Price-Poole of Canada, Ltd., Box 969, Cranbrook, B. C., Canada. *Alberta Natural Gas Co.* — 107 miles of 36-in. from Crowsnest Pass to the Idaho boundary at Kingsgate-Eastport. Joint venture of H. C. Price Co. of Canada, Ltd. Calgary, and Poole Construction Co., Ltd., Edmonton. C. E. Shivel is superintendent, and Wayne McKnight is office manager at Cranbrook, B. C. Entire line double jointed and yard enamel coated by Price-Poole pipe coating division.

R. E. Reutzel Co., Inc., Box 727, Fremont, Neb. *Northern Natural Gas Co.* — 116 miles of 2, 3, 4, 6 and 8-in. in South Dakota. Spreadman: James Adcock. Office manager: R. E. Whitworth.

S.A.I.P.E.M., Casella Postale 4159, Milan, Italy. *Oil India Private, Ltd.* — 720 miles of 14, 16 and 18-in. from Nahorkatiya to Barauni.

Baghdad, Iraq, Ministry of Industry — 56 miles of 10, 14 and 18-in. from Rumaila to Basrah.

SNAM (Oleodotti Internazionali) — 118 miles of 24 and 26-in. from Genoa to Ponte Tresa; 120 miles of 16 and 18-in. from Ferrera to S. Bernardo; 53 miles of 22 and 24-in. from Ponte Tresa to S. Bernardino; 90 miles of 22-in. from S. Bernardino to St. Margrethen; and 37 miles of 16-in. from S. Bernardo to Aigle. Also for SNAM, 59 miles of 18 and 20-in. from Cremona to Bologna.

Y.P.F. (Buenos Aires, Argentina) — 106 miles of 6, 8 and 10-in. in the Comodoro oil field.

Shamrock Construction Co., Box 1177, Lansing, Mich. *Northern Natural Gas Co.*—130 miles of 2 through 8-in. laterals in Iowa.

Sharman, Allen, Gay & Taylor, Inc., Box 13152, Houston, Tex. *Dixie Pipe Line Co.* — from the Mississippi River to Demopolis, Ala. —a portion of the 1100-mile, 6, 8, 10 and 12-in. LPG line.

Sheehan Pipe Line Construction Co., 514 National Bank of Tulsa Bldg., Tulsa, Okla. *Transwestern Pipeline Co.* — has underway an additional 250 miles on the 4, 6, 8, 10, and 12-in. gathering system in Oklahoma and Texas.

SunOlin Chemical Co. — 50 miles of 6-in. and 30 miles of 4-in. in New Jersey from Paulsboro to Deepwater. C. M. Brown is superintendent.

Somerville Construction Co., 6648 Fulton Rd. East, Ada, Mich. *Michigan Wisconsin Pipe Line Co.* — 26

the Detector that Lets You see BURIED HOLIDAYS

The new Pipetron all-transistorized Model 506 Detector "looks through the soil" to give you meter-accuracy to pin-point buried holidays . . . and provides a strong audio signal for positive 2-Way detection.

Both the powerful professionally designed detector and transmitter are equipped with meters for high accuracy to reduce digging to an absolute minimum. The unit also locates pipelines and shorts.

Write for complete facts about this compact, easy-to-handle instrument in our circular "You Can't Afford to Keep Buried Holidays a Secret".

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Sales territories available — inquiries invited.

miles of 30-in. in Ottawa, Allegan and Berrien counties, Mich. Headquarters: Ada. Superintendent: Harold Cook.

Stanley-Bledsoe Corp., 612 Daniel Bldg., Tulsa 3, Okla. *Dixie Pipe Line Co.* — 30 miles of 8-in. and 96 miles of 6-in. from north of McBee, Chesterfield County, S.C., to south of Apex, Wake County, N.C. Headquarters: Cherau, S.C., and Sanford, N.C.

United Gas Pipe Line Co. —approximately 40 miles of 30-in., including a crossing of the Red River, from south side of the river located in Avoyelles Parish, La., northerly to LaSalle Parish. Field office: Alexandria, La. Superintendent: M. T. Wilhite.

Taylor Woodrow Services Ltd., 345 Ruislip Rd, Southall, Middlesex, England. *Scottish Gas Board* — approximately 2 miles of 12 in. across Tay Railway bridge, Dundee, Scotland. J. Reeves is in charge. J. W. Ashton is contracts manager. G. Carr is project manager.

Tulsa Williams Co., 326 National Bank of Tulsa Bldg., Tulsa 3, Okla. *Texas Eastern Transmission Corp.* — 40 miles of 30-in. (four loops) across Pennsylvania. M. O. Thompson is superintendent. Headquarters: Mt. Union.

Vaughn & Taylor Construction Co., Inc., Box 3266, Odessa, Tex. *Western Slope Gas Co.* — 110 miles of 2 through 8-in., with laterals, from Del Norte, Colo., to Antonio, with D. D. Vaughn as general superintendent. Field office: Alamosa.

Western Pipe Line, Inc., Box 1076, Austin, Tex. *Texas Eastern Transmission Corp.* — 18-mile, 30-in. from southwest of Wilkesville, Vinton County, Ohio, to near Athens compressor station; and 12-mile, 30-in. from south of Moundsville, W. Va., to Holbrook station near Wind Ridge, Green County, Pa. J. B. Miller is superintendent. Harry Murphy is field office manager at Albany, Ohio.

Texas Gas Transmission Co. — approximately 31 miles of 26 and 30-in. in Tennessee and Kentucky. Ervin Simpson is superintendent. Russell Hardy is field office manager at Dyersburg, Tenn.

Pipeline Equipment

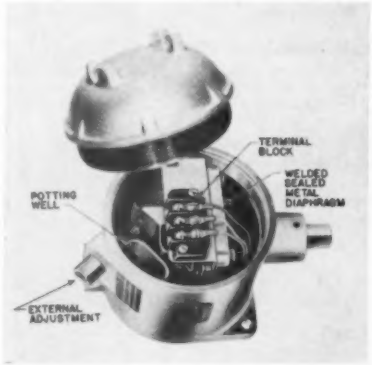
For Tanks Up to 24 Ft

Dir-O-Gage is a float operated liquid level indicator with easy-to-read dials calibrated in feet, inches and ⅛ in. It is supplied complete with all components and hardware for installation on bolted or welded tanks up to 24 ft in height. Dir-O-Gage requires no electrical power, air pressure or other supply source. A Neg'ator motor built into the gage head provides needed power to wind and unwind the tape as float follows the level. It also features up to eight individual adjustable electric alarm switches in an explosion-proof housing. *Instruments, Inc.*

Circle number (81) on reply card

Pressure Switches

Explosion-proof diaphragm pressure switches with set and re-set accuracy of ±½% can be adjusted externally without exposing the circuit. Housings are built with pottable electric outlets. Integral terminal blocks provide wiring convenience. Diaphragm capsules may be interchanged easily for varying pressure requirements or fluid



characteristics. In low setting, switches actuate at 0.1-in. mercury with proof pressure to 10 psi; in higher ranges, up to 300 psi proof pressure at settings to 150 psi. Standard pressure connection is ¼-in. npt female pipe fitting. Single setting and dual control models are available. *Barksdale Valves.*

Circle number (82) on reply card

Cleaner With Rotating Head

Spin-Blast is a new type internal pipe cleaner that eliminates need for pipe rotation during internal cleaning. It is composed of nozzle head, feeder tube, governor, bearings, seal and seal adjusting screw. A special wrench for the latter is provided. A mixture of air and abrasive goes through the tool into the nozzle head and is forced out two nozzles, causing the head to rotate and blast the abrasive around the entire ID of the pipe. All types and sizes of abrasives, including peening shot, may be used. The unit is designed to remove rust, paint, carbon, mill scale and other foreign deposits in pipe from 6 to 36-in. ID. *Clemtex, Ltd.*

Circle number (83) on reply card

Digital Scanner, Converter

Discon (digital scanner and converter) "reads" dial and pointer instruments, gages and meters and provides a remote digital output. Instrument dials from 3 to 20 in. diam can be accommodated. The device also can be used as simple deviation alarm or "upset" indicator to read out only on change of static condition with hi-lo-go units. Operating photoelectrically, the scanner unit "bridges" existing instrument dial and mounts outside instrument flange. With no physical alteration or connection to the instrument's shaft or pointer, there is no friction or inertia loading on the sensing element. Fully pneumatic or mechanical meters can be read. The scanner can be mounted without taking existing meters out of service. A wide range of scanning rates, from 1 per min to 6000 per min or upon command only is offered. *MacLeod Instrument Corp.*

Circle number (84) on reply card

Enamel Coating Reinforcement

A reinforcement to help enamel coatings ward off corrosive elements has been announced. Glass fibers and yarns are pressed into a mat to form Coromat inner wrap. A new binder applied to the fibers and yarns makes Coromat more flexible and easier to handle. Fibers are held more tightly to resist flying off the mat when it is applied under mechanical stress around a pipe. When passed through the pipeline enamel, Coromat allows air and gas bubbles to escape. *Owens-Corning Fiberglas Corp.*

Circle number (85) on reply card

Protects Machinery

The A-29713 Lub-Sentry protects machinery against damage due to lack of oil in lubricator or mechanical failure of the drive mechanism, and gives added protection in event of motor burnout where lubricators are electrically operated. Unit consists of standard lubricator feed that circulates oil through a contained pressure valve. A relief valve that discharges at 100 psi allows oil to return to the reservoir. The unit assembles into lubricator pump space. Standard pressure switches can be used to control an electric warning signal. Tapped opening for a pressure gage also is provided. *McCord Corp.*

Circle number (86) on reply card

Interlock Relays

Series SIL Mechanical-Interlock, a bi-stable relay, indefinitely holds an armature operated after the coil is de-energized. Series SEL Electrical-Interlock relay has the same configuration as the SIL except that the mechanical linkage is omitted. The shock and vibration-resistant SIL is available with coils for a number of d-c voltage ratings up to 110 plus diode-rectified 110-v a-c. The SEL, wired so that both relays are controlled by pulsing over a single lead, is available with coils for a number of d-c voltage ratings up to 60. Life expectancy of the SIL is 10,000,000 operations and of the SEL, 30,000,000 operations. Wide application includes computer and machine sequence control, as well as alarm circuitry. *Automatic Electric.*

Circle number (87) on reply card

Simple Digital Telemetering

Digital telemetering equipment (type DL) is offered for relatively simple applications, such as the telemetering of positive displacement on pipelines, and for operating with Visicode supervisory control systems. For each pd reading to be telemetered, a contact device on the meter feeds incremental impulses into a register unit at the remote station. When a telemetered reading is required, the readout transmitter sends the reading of the register to the master station where it is indicated or logged. The equipment uses telephone relays and stepping switches. Data is transmitted over any telegraphic channel in binary-coded decimal form by long and short pulses and spaces. *Westinghouse Electric Corp.*

Circle number (88) on reply card

Metal-Faced Sheet Insulation

Speed-Insul panels, combining efficient insulation material with diamond-rib sheet aluminum facing, offer a time and labor-saving method of applying sheet insulation in locations where a weather-resistant facing is required, such as on outdoor tanks. It is supplied in sheets about 50 in. wide by 100 in. long to provide a net insulation coverage of 4 ft by 8 ft when applied with recommended overlap. Speed-Insul sheets can be cut and drilled, as necessary, in the field using standard electric sabre saw and hand drill. *Johns-Manville, Insulation Div.*

Circle number (89) on reply card

THE C-R-C PIPE SLING

- **SAFE:** Sling has no humps or projections to dig into surface of coated pipe.
- **THIN:** Only 5/8" thick. Ideally suited for narrow ditches.
- **STRONG:** Tested lifting capacity of C-R-C Pipe Sling* — up to 216,000 lbs.
- **FLEXIBLE:** Strong, steel-wire links enclosed in heavy-duty rubber give this husky sling flexible strength.
- **UNFASTENS EASILY:** Especially designed sling iron permits quick — easy, fastening and unfastening after pipe is in the ground.

* *Patent applied for.*

SERVING PIPELINERS SINCE 1933

CRC

CRUTCHER · ROLFS · CUMMINGS, INC.

Home Office: Houston, Texas, Box 2073, OVerland 6-4301

Export Office: D. T. O Connor, Inc., 500 Fifth Avenue, New York 36, N. Y., BRyant 9-2236
In Canada: Canadian Equipment Sales & Service Co., Ltd., 7310 99th St., Edmonton, Alberta, Canada

High-Pressure Plug Injector

A Kinney plug injector with a pressure capacity of 5000 lb has been developed to scrape paraffin and sand from high-pressure pipelines. It permits use of either soluble asphalt-base plug or nonsoluble, brush-type "pig" to clear accumulations from interior walls. It is designed with rubber seat sealing element to effectively seal in high pressure gas and distillate service. *Alco Products, Inc.*

Circle number (90) on reply card

Ups 2-Way Radio Coverage 43%

The RASER (Range and Sensitivity Extending Resonator) is being incorporated in the high band GE Transistorized Progress Line of mobile radios to improve distance covered up to 43% and to provide clearer, sharper, more distinct messages. All equipment supplied with the new RASER will have sensitivity better than 0.5 microvolts. The new approach means an improvement of up to 6 db over conventional transistorized receivers. *General Electric.*

Circle number (91) on reply card

Arnofoam In New Lengths

Now available in longer lengths per roll at a more economical unit price is Arnofoam, a polyurethane foam, pressure-sensitive insulating tape. It is supplied in ⅛, ¼ and ½-in. thicknesses and lengths of 100, 75 and 30 ft, respectively. A new technique in winding compresses the foam on a 1½-in. core. The foam recovers its original thickness almost immediately upon unwinding. Package size has been reduced by more than 50%, while lineal feet per package have been increased. *Arno Adhesive Tapes, Inc.*

Circle number (92) on reply card

New Microwave Systems

Microwave transmitters and receivers operating in the 6 to 8 kmc and 11 to 15 kmc frequency ranges have been introduced. Transmitter power outputs of 100 milliwatt and 1 w are available in the 6 to 8 kmc range and 50 and 500 milliwatts in the 11 to 15 kmc range. The new systems are especially applicable for wide band data transmission, high density communication systems and video relaying over long multi-hop systems. *Alpha Corp., Div. of Collins Radio Co.*

Circle number (93) on reply card

Fast-Drying Coating

A cold-applied, fast-drying, heavy-duty, self-priming coal-tar base protective coating has been formulated as an initial protective coating or patching for exterior surfaces of buried pipe, tanks and fittings. Bitumastic No. 505 permits rapid backfill. Ingredients do not settle during storage periods. Since it is thixotropic, it requires a minimum of agitation prior to application. Rate of application is 50-70 sq ft per gal. An average coverage of 60 sq ft per gal will surface dry in approximately 45 min to 1 hr, depending upon temperature and humidity. It may be applied by brush, roller, "handglove" or mechanical spray methods. *Koppers Co., Inc.*

Circle number (94) on reply card

Foamed Plastic Pig

Designed primarily for removal of water after hydrostatic tests, Sweegee is a cylindrical, bullet-like, foamed plastic pig available in sizes to fit any pipe through 48-in. ID. It may be used also in plant process lines to remove water, rust and debris, replacing temporary strainers prior to start-up. It will not stick in heavy-walled river crossings, will go around short radius 90-deg or even 180-deg bends and will traverse lines with different wall thicknesses as well as reduced diameters. For open-end pigging,

MODEL RMT
NOW
specific
GRAVITY RECORDING
OF LIQUIDS AT ANY
DISTANCE
Accurate long-distance transmission of specific gravity recordings is no longer a problem with any of the new RMT Models of Arcco-Anubis Recording Gravitometers for recording and transmitting liquid gravity records. These instruments combine the mechanism of the standard Arcco Liquid Gravitometer with a metameter telemeter transmission system which records and transmits the specific gravity record to control room or other remote location. The inter-connecting line may be any two-wire electrical circuit or its equivalent: private wires, telephone circuits, carrier current channels, or radio (VHF or UHF).
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MANUFACTURERS OF PRECISION INSTRUMENTS

catch joints are unnecessary. An 8-in. Sweegee weighs less than 1 lb; a 20-in., less than 15 lb. *SWECO, Inc.*

Circle number (95) on reply card

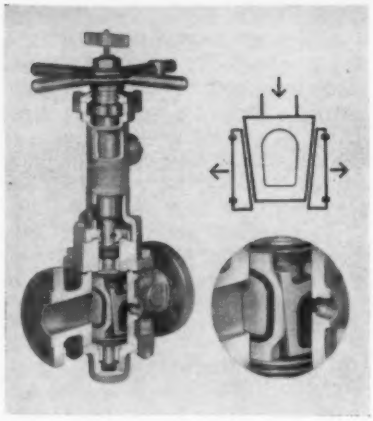
Electrohydraulic Actuator

Custom designed for specific applications is a new 20,000 series electrohydraulic actuator. Model EHA-1 provides a means of converting a suitable electrical signal from an automatic or manual electrical control station to a powerful hydraulic force. Normally mounted on an Annin control valve, it may be used also to actuate other devices such as large butterfly valves, etc., where large loads or unbalanced forces are encountered and where positional stiffness or high response speed are requisites. *The Annin Co.*

Circle number (96) on reply card

Improved Plug Valve

An improved non-lubricated, plug-type valve provides bubble-tight seal at upstream and downstream ports with body bleed for positive checking of seal. A patented plug-assembly with two replaceable seating



segments avoids abrasive-contact of seating surfaces. When the plug moves downward, these seating segments are wedged outward to effect a double block. When the plug moves up, segments retract and disengage from body seats before plug is rotated. This perpendicular sealing action of the Twin Seal model C eliminates galling or scoring of seats and permits use of soft, resilient seals. *General Valve Co., Inc.*

Circle number (97) on reply card

Explosive Gas Detector

Gas-O-Larm detector model 350 is a new safety device that indicates concentration of explosive gas. It operates on the catalytic platinum filament principle and may be calibrated for any flammable gas or other hazardous vapors. Operating on dry cell batteries for portability, it is actuated by an electrically operated probe containing a detector element. The instrument panel controls the operation and contains spare detector elements should the one in the probe become inoperative. *Beard Instruments, Inc.*

Circle number (98) on reply card

Literature

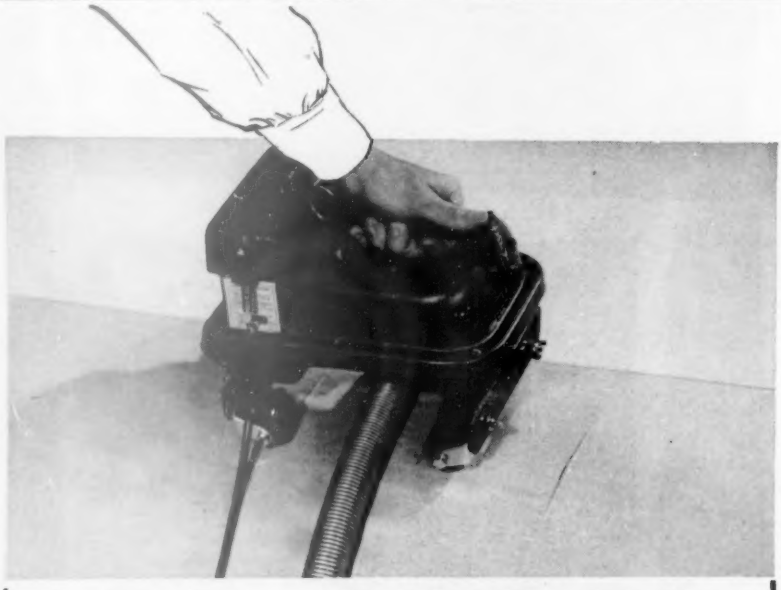
Power Digest

Engines spanning the range of 190-2150 bhp are featured in a 4-pager. Brief descriptions and specifications of 26 models of six basic Superior engines are supplemented by references to other literature giving more comprehensive coverage of individual models. *White Diesel Engine Div., The White Motor Co.*

Circle number (99) on reply card

Valve Report

General pipeline and manifolding service valves, cast steel and high pressure gate valves and regular



BE SURE!

ELIMINATE HOLIDAYS and their consequences with accurate, reliable SPY Holiday Detectors. Compact and light in weight for one-man operation. Carrying or rolling models available. Detectors set to your job specifications:

- **all voltages**
- **all pipe sizes**
- **all types coatings**

Anywhere in the world
SPY
HOLIDAY DETECTORS
are as near as your telephone. In emergencies our own plane assures immediate service.

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port valves are the subject of a concentrated, 18-page, technical report. *Grove Valve and Regulator Co.*
Circle number (100) on reply card

Truck Crane Portfolio

Features and capabilities of the new 25-ton-capacity P&H 325-TC truck crane are contained in a 12-page technical portfolio. It includes operating specifications of each front end attachment, supported by capacity charts, general dimension drawings, crane range diagram, cutaway photographs and on-the-job illustrations. *Harnischfeger Corp.*
Circle number (101) on reply card

"How To" Booklet

A 16-pager offers instructions and welding tips useful in repairing and rebuilding worn parts. Typical applications are dipper teeth, tractor grouser bars and crusher parts. *American Manganese Steel Div., American Brake Shoe Co.*
Circle number (102) on reply card

Instrumentation Symbols

"Suggested Flowsheet Instrumentation Symbols" is a 4-page reference bulletin listing symbols used in drawing process flow sheets and schematic control systems. In most respects, the symbols follow Recommended Practice outlined by the Instrument Society of America. *Fischer & Porter Co.*
Circle number (103) on reply card

Welding Wire Guide

A catalog describes Oxweld wires and rods for all continuously-fed electrode welding processes such as submerged arc, mig and CO_2 — flux, and wires and rods used as filler metals for tig welding. The guide lists available forms, sizes, packages and chemical compositions. *Linde Co.*
Circle number (104) on reply card

Temperature Transmitter

A 12-page bulletin illustrates how easily type 12A pneumatic temperature transmitters can be installed and adjusted to suit a wide range of application requirements. Detailed specifications, descriptions of operating principle, temperature range table and related accessories also are included. *The Foxboro Co.*
Circle number (105) on reply card

Samples Directly from Line

A pneumatic actuated liquid sampler for flowline fluid sampling at the rate of 10 to 500 samples per min is described in a bulletin. The new product consists of: sampler valve that screws directly into the line; pulser that applies and releases pressure on the valve diaphragm to reciprocate a ball in the valve between two seats; and container for the fluid sample being taken each time the ball moves from one seat to the other. The sampler operates at 20 to 30 psi, and the valve will handle pressures from 10 to 1500 psi. *Odex Engineering Co.*
Circle number (106) on reply card

Gas Regulators Cataloged

A 40-page catalog covers a wide choice of gas precision regulators for all applications, including pipeline stations. Quick-reference charts indicate range and variety. Cross-referenced, illustrated layout, in which all regulators are classified according to use, provides a convenient way of finding information in the catalog. *Air Reduction Sales Co.*
Circle number (107) on reply card

The most effective PIPE LOCATOR in the world

FIELD PROVED

the award winning

"Signalmaster"

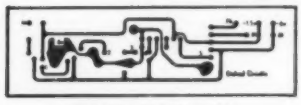
TRANSISTORIZED

PIPE LOCATOR

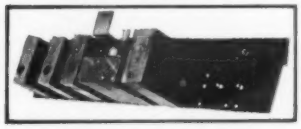
MODEL TR-1A

Utility and Construction Companies, Municipalities are unanimous in agreeing that MODEL TR-1A has proved most effective for locating mains, services, valves, conduit, high voltage lines, telephone cables. Easily separates parallel lines and can be used to trace non-metallic pipe lines. Complete piping systems traced out.

SPECIFICATIONS: Size of cases when clamped together: 9½" x 12½" x 5½" • Size of transmitter and receiver boxes, each: 9½" x 12½" x 2¾" • **Operating weight,** transmitter: 4½ lbs. • **Operating weight,** receiver: 4¾ lbs. • **Circuit:** Transmitter—one transistor, Receiver—six transistors • **Batteries:** Transmitter—4 size C flashlight cells, Receiver—4 size C flashlight cells • **Switching:** a. Automatic power switching for all "on-handle" operations. b. Automatic "turn-off" when set is not being used.



ETCHED CIRCUITRY



ENCAPSULATED PARTS

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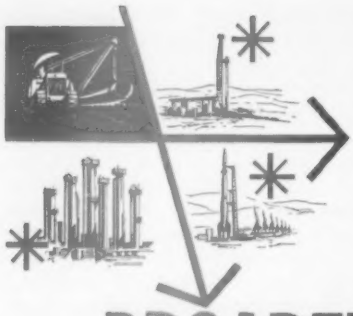

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The work of Burden in the North American Pipe Line System Construction field is well known. With the broadening of the world petroleum and gas industry Burden has been actively engaged in work abroad and is now in position to contract for work anywhere.

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PIPELINE CONSTRUCTION AND RECONDITIONING DRILLING / REFINERY, CHEMICAL PLANT AND MISSILE BASE CONSTRUCTION THROUGH WHOLLY-OWNED OR AFFILIATED COMPANIES.

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Pipeline Parade

Dresser Electronics' control division has received a contract from Nordberg Manufacturing Co. for automatic, electronic start-up control systems for four diesel engines. The equipment will be supplied to Lakehead Pipe Line Co. for installation at their Saxon, Wis., station.

Keenan Pipe & Supply Co. has been appointed distributor in Southern California, Arizona, Nevada, and Colorado for ACF lubricated plug valves made by W-K-M Div. of ACF Industries.

A. O. Smith Corp.'s meter and service station equipment division has received a contract to supply all line meters for the West Shore Pipe Line. Specifically involved are 18 dual case rotary positive displacement meters with rate of flow up to 3000 bbl per hr and three single case rotary positive displacement meters with flow rate of 1320 bbl per hr.

Hart Industrial Supply Co., Oklahoma City, Okla., is now distributor of Worthington Corp.'s air cooled and water cooled compressors. Territory includes Oklahoma, except Ottawa, Craig and Delaware counties.

Pittsburgh Chemical Co. has appointed Aztec Tubes, Inc., Houston Tex., as sales agent for Pitt Chem pipeline enamels and Tarmastics and Tarset in Texas, Louisiana, New Mexico and Mississippi.

Appointments and Promotions

Allis-Chalmers Manufacturing Co.—Dane T. Scag, assistant director of research in charge of the research division's development de-

NEW AND EXCLUSIVE with McCord Model 55 Lubricator

SAFE-LEVEL SIGHT FEED

That's right! The finest lubricator on the market today has been refined to give you even *more* for your money. Now, the McCord Model 55 Lubricator comes equipped with new, exclusive Safe-Level Sight Feed with these outstanding benefits for you . . . safe, sure warning of malfunction . . . quicker priming . . . better feed regulation . . . extreme accuracy . . . improved reliability. IMPORTANT: Safe-Level Sight Feed can also be added to existing Model 55 Lubricators.

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partment and engineers and scientists in the firm's magnetohydrodynamics laboratory at Newport Beach, Calif.

AiResearch Manufacturing Div., The Garrett Corp. — Robert A. Fletcher to the newly-created post of sales manager, industrial gas turbines.

Chicago Pneumatic Tool Co. — Russell B. Miller, general sales manager.

Continental-Emsco Co., Fibercast Div. — Phillip J. Liston, assistant general sales manager in charge of special projects, formerly district sales manager; and Marion F. Hutchison, district sales manager for California, Oregon, Washington and Arizona.

The Foxboro Co. — Howard R. Cushman, regional sales manager for the New York territory, succeeding John E. Hewson who has been appointed field manager of the systems engineering division.

Grove Valve and Regulator Co. — Kenneth S. Adamson, application engineer specializing in regulators.

Jones & Laughlin Supply Div. — N. A. Myers, salesman previously assigned at Lake Charles, La., is now in Lafayette; and G. N. Jones, formerly salesman at Glendive, Mont., now assigned to Lake Charles.

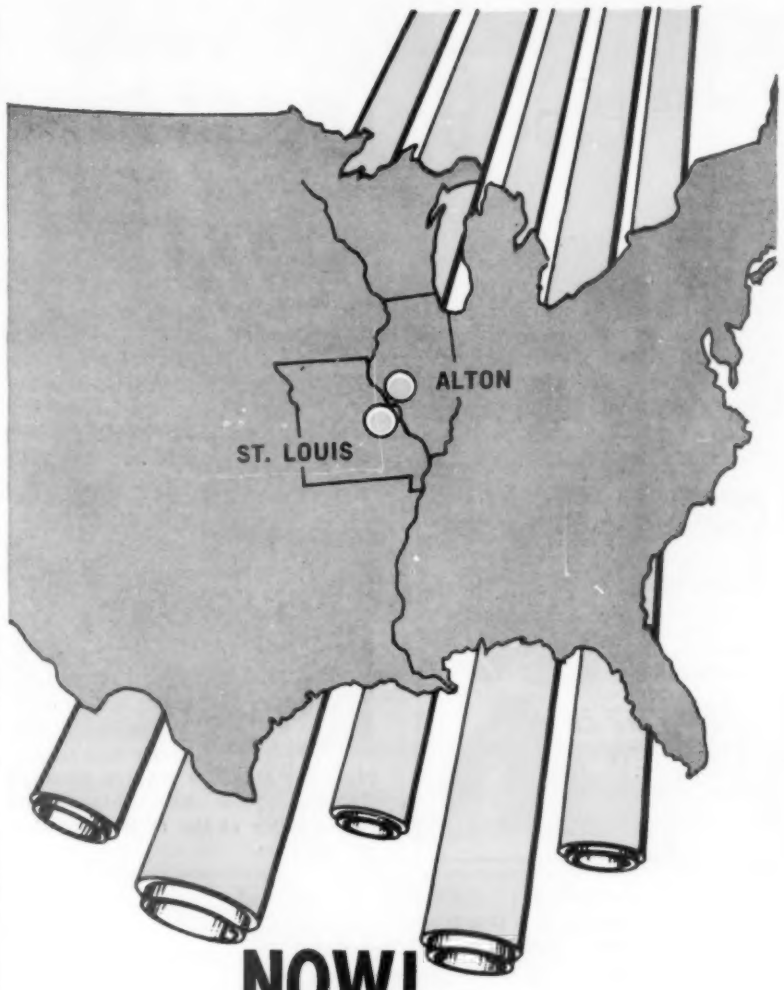
Pittsburgh Chemical Co. — William H. Jaynes, vice president, as well as general manager, of the protective coatings division.

Schield Bantam Co.—Vern Pray, domestic sales manager, formerly sales development manager.

TRW Computers Co., division of Thompson Ramo Wooldridge Inc.—Ray J. Stanish, general sales manager, formerly central regional sales manager in charge of the Chicago office.

Universal Field Services Inc. — Fred A. Crane, right-of-way consultant. He also has been elected vice president of the firm. He recently retired as superintendent of Sinclair Pipe Line Co.'s right-of-way department.

Standard Pump Div., Worthington Corp. — Patrick L. McManus, general manager, formerly director of marketing services.



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Standard Pipeprotection's new plant at Alton, Illinois has been shipping Standard X-Tru-Coat pipe to the Southwest and West since early July. Sizes available include ¾" Nom. through 4½" O.D.

X-Tru-Coat high density polyethylene plastic coating for pipe is produced under the DeKoron process — Pat. Nos. 2,447,420 and 2,467,642 — and is extruded on pipe over a pressure sensitive adhesive.

Standard Procedures assuring top quality prevail at the Alton, Illinois plant, as they have for many years at SPI's coating and wrapping plant in St. Louis. In-Transit privileges are available at both plants from any pipe mill.

Standard Pipeprotection, with the introduction of X-Tru-Coat, has continued to contribute to the progress of the oil and gas industry.

Write for complete information and for Price List Number X-1.

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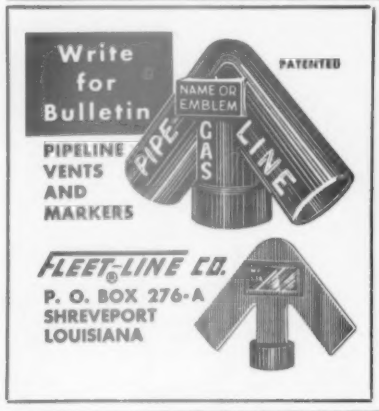
For Further Information on Advertised Products See Reader Service Card

Pipeline People

Dr. Elton Soltes has been appointed general manager of Delhi-Taylor Oil Corp.'s new gas sales and pipelines division that will coordinate all natural gas activities, including sales, contract negotiation and operations of Delhi Pipeline Corp. and Natural Gas Gathering Co., Inc. Under Dr. Soltes' supervision will be the natural gas pipeline department and minerals exploration department.



Now directing entire pipeline operations of The Buckeye Pipe Line Co. is George L. Robinson, vice president of operations who formerly was responsible for only the eastern products division operations. Robinson will headquarter at the New York office of the firm.

Winston J. Woellert is new personnel relations manager for Continental Pipe Line Co., succeeding Max E. Stansbury who has been transferred to Houston as director of Continental's labor relations division. Woellert, formerly director of the firm's wage and salary administration division, will make his new headquarters in Ponca City, Okla.

Humble Pipe Line Co. has promoted D. C. Lamm to Midland area manager, succeeding J. F. McCarthy who is retiring. Lamm has been assistant area manager since 1960 when the West Texas and North Texas divisions were consolidated into the Midland area.

H. B. Lafferty, manager of systems dispatching for El Paso Natural Gas Co., has been named regional representative to the American Gas Association's gas requirements and supply committee which will study future supply and demand for natural gas.

Managing Skelly Oil Co.'s new crude oil department is William H. Nichols, formerly manager of Standard Oil Co. of Ohio's crude oil section of the supply and trans-

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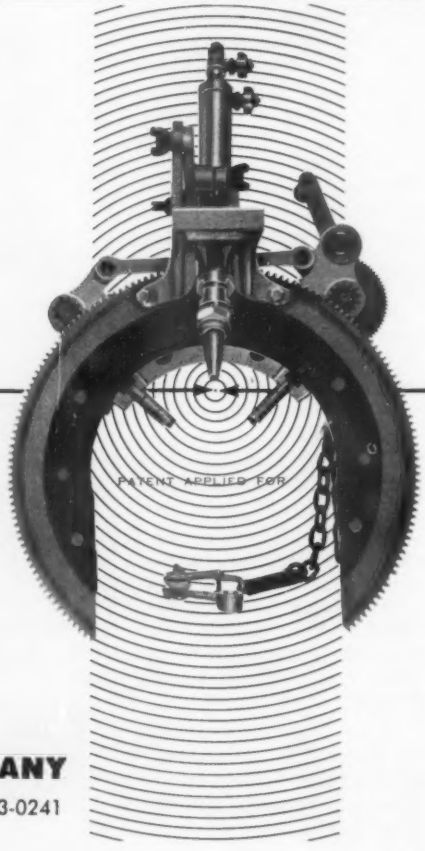

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T M Reg

portation department. In his new position with Skelly, Nichols will supervise crude purchases and sales and coordinate the new department's functions with the pipeline department.

Tom K. Davis, formerly vice president of Tennessee Gas Pipeline Co., has been elected president and a director of East Tennessee Natural Gas Co. As president, he succeeds John C. Bolinger, Jr., who has been named to a new executive post with Tennessee Gas Transmission Co. Bolinger continues as an East Tennessee director.

V. V. Miller, Service Pipe Line Co. station foreman at Hankamer, Tex., has been transferred to Center, Mo. William W. White, section head in the firm's engineering department, has been assigned temporarily to Casper, Wyo., assuming the duties of R. H. (Bob) Christman, division chief engineer who is on special assignment in North Dakota.

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Big machine performance

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Anticipating every need to protect your pipe . . . Midwestern's line includes: . . . KERMAC outerwrap . . . KEYSTONE asbestos felt . . . KAPCO rock shield . . . COROMAT underground wrap . . . GLASFAB brand handwrap . . . GLASKOTE torch-applied joint wrap . . . POLYKEN tape coatings.

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- Oklahoma City, Okla.
- Des Moines, Ia.
- New York, N.Y. (export)
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THIS INDEX IS PROVIDED AS AN ADDITIONAL SERVICE FOR OUR READERS
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An exclusive summary of contract rigs . . . world-wide . . . available for work, featuring rig location, type, specifications, contractor's name and address, major divisions: rotary, cable tools, well servicing, offshore . . . and new expanded international section. FALL 1961
RIG LOCATOR
A SUPPLEMENT TO
Petroleum Engineer
BOX 1589 • DALLAS 21, TEXAS

CHICAGO PNEUMATIC · OIL TOOL DIVISION · FORT WORTH, TEXAS

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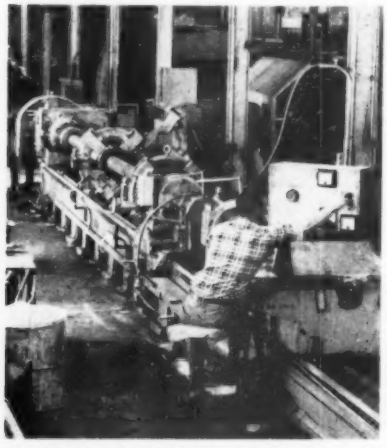

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18th EDITION FALL 1961

WORLD-WIDE

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Including U. S. and Canadian Well Servicing Units

Plus Enlarged International Section

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RIG LOCATOR

This is the 18th Edition and marks our sixth anniversary: 1955 to 1961! The basic format of the RIG LOCATOR has not changed since the first edition published with the October 1955 issue of PETROLEUM ENGINEER. It is now worldwide in scope and includes well servicing and workover rigs in addition to rotary and cable tool rigs.

Only contractor equipment has been listed in keeping with its basic aims and purpose: to serve the producer by providing him with a complete list of rigs to meet his requirements in almost every area where wells are drilled; and to serve the contractor by briefly describing his rigs with pertinent specifications along with current rig location. "Captive" or producer-owned and operated rigs are NOT included in the RIG LOCATOR.

$75,000 Worth

In six years, PETROLEUM ENGINEER has spent an estimated $75,000 for 18 editions of the RIG LOCATOR. The service has always been free to all contractors. Has this service been worth the cost and effort? If this rig directory service has helped the contractor get just one job... or chance to get one job... we feel it has served its purpose. It may be difficult to say what helped most in getting a contract, but we do have definite proof of many contractors getting jobs because of their listing in the RIG LOCATOR. Others acknowledge that their name was added to a bid list as a result of listing their equipment in past issues. Your suggestions and ideas for its improvement are always welcomed. Write: Rig Locator Editor, P. O. Box 1589, Dallas 21, Texas.

Abbreviations

An asterisk (*) before the rig number indicates the rig is also available for workovers. Type of power is abbreviated as follows: dsl for diesel; gaso for gasoline; stm for steam; btne for butane; dsl-elec for diesel-electric. Manufacturers' names are abbreviated as follows.

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Hopper Machine Works, Inc.	Hopper
Houston Tool Co.	Hou
Howard-Turner Machine Works	Howard-Turner
Ideco, Inc.	Ideco
Ingersoll-Rand Co.	Ingersoll
Jones, Shelburne & Guffey Co.	JS&G
Joy Manufacturing Co.	Joy
Lucey Export Corp.	Lucey
Mayhew Supply Co., Inc.	Mayhew
Mid-Continent Supply Co.	M-CSCO
Lee C. Moore Corp.	L. C. Moore
Muskogee Iron Works	MIW
The National Supply Co.	Natl
Oil Well Supply Division (U. S. Steel)	"Oilwell"
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Spencer-Harris Machine & Tool Co.	Spencer
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The Wheland Co.	Whlnd
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Wichtex Machinery Co., Inc.	Wichtex
Wilson Manufacturing Co., Inc.	Wlsn

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Anderson Drlg Co 730 Wichita Natl Bk Bldg Wichita Falls Tex
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B

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Barrett Drlg Co 423 Masonic Bldg Shawnee Okla
Bass Drlg Co 905 San Jacinto Bldg Houston 2 Tex
Bass Robert M Drlg Contr Box 471 Kilgore Tex
Bay City Drlg Co Inc Box 1389 Bay City Tex
W Harlan Beene Drlg Co Inc Box 5218 Bossier City La
Bennett & Roberts Drlg Inc Drawer 633 Russell Kans
Berry Drlg Co Box 67 Saint Jo Tex
Bickerstaff and Tibbets Drlg Co 406 N Marienfeld Midland Tex
J C Bickham Drlg Co Inc Box 657 Richmond Tex
Big Chief Drlg Co Box 8837 Oklahoma City 14 Okla
Big Horn Drlg Co Inc Box 2068 Casper Wyo
Big Seven Drlg Co 311 Wright Bldg Evansville Ind
Big "6" Drlg Co 225 Oil & Gas Bldg Houston 2 Tex
Big X Drlg Co Inc 2905 First Natl Bldg Oklahoma City Okla
Black Drlg Co 525 Petroleum Bldg Abilene Tex
Blackstone Forest Inc V & J Tower Bldg Midland Tex
Bodard Drlg Co 313 Masonic Bldg Shawnee Okla
Bolin Oil Co & D H Bolin 1120 Oil & Gas Bldg Wichita Falls Tex
Boyd & Durst Drlg Contr Box 329 Alice Tex
Brannon & Murray Drlg Co Box 672 Coleman Tex
Brantly Drlg Co Inc Box 4935 Midland Tex
Brehn C E Drawer 618 Mt Vernon Ill
Brewster-Bartle Drlg Co Inc 1919 Bk of Southwest Bldg Houston 2 Tex
Brooks Zach Drlg Co Box 31 El Dorado Ark
Brown Drlg Co Box 197 Long Beach Calif
Bryant Harry T Co Ltd Box 13364 Houston 19 Tex
Bryant-Hayward Drlg Co Box 4627 Oklahoma City Okla
Bueno Drlg Co 207 Continental Oil Bldg Denver 2 Colo
Burns Drlg Co 1003 S St James Blvd. Evansville 14 Ind
Buzzini Drlg Co Petroleum Center San Antonio 9 Tex
Byars B G Power Drlg Co 624 Citizens Bk Bldg Tyler Tex

C

C N P Drlg Co 514 Staley Bldg Wichita Falls Tex
Cactus Drlg Corp of Tex Box 348 San Angelo Tex
Caldrill Inc 340 Loma Vista Rd Ventura Calif
Calvert Drlg Inc 918 Natl Bk of Tulsa Bldg Tulsa Okla
Camay Drlg Co 4250 Wilshire Blvd Los Angeles 5 Calif
Camay Drlg Co Rocky Mt Div 1535 Denver Club Bldg Denver 2 Colo
Camden Drlg Co Box 1418 Corpus Christi Tex
Capitan Drlg Co Inc Box 671 Odessa Tex
Capitt Drlg Co 814-16 Union Center Wichita 2 Kans
Caraway Frank Drlg Co Box 982 San Angelo Tex
Carper Drlg Co Inc 200 Carper Bldg Artesia New Mex
Carter-Jones Drlg Co Box 1597 Kilgore Tex
Catline Dodson Co Inc Box 8503 Oklahoma City Okla
Chiles Drlg Co Box 949 Alice Tex
Circle "A" Drlg Co Inc 340 Denver Hilton Office Bldg 9 Denver Colo
Circle Drlg Co Inc 620 Pioneer Bldg Lake Charles La
Clark Dan L Drlg Co 819 Wilson Tower Corpus Christi Tex
E B Clark Drlg Co 612 City National Bank Bldg Wichita Falls Tex
Clawson Don Townsend Bldg Ada Okla
Claypool Drlg Co Box 98 St Elmo Ill
Clegg & Hunt 715 Houston Club Bldg Houston Tex
Coastal Drlg Co 7300 Downing Ave Bakersfield Calif
Colorado & Western Drlg Co 1119 Mile High Center Denver 2 Colo
Columbia Drlg Co 1207 C & I Life Bldg Houston 2 Tex
Conrey Drlg Co 328 E Broadway Centralia Ill
Cook Drlg Co 2305 Continental Life Bldg Ft Worth Tex
Cooper Drlg Co 902 Staley Bldg Wichita Falls Tex
Crawford Drlg Co Box 622 Shreveport La
Cross Jess P Drlg Contr 1216 Texas St Graham Tex
Crow Milton Inc 420 Commercial Natl Bk Bldg Shreveport La

D

D & M Drlg Co Inc 809 Union Center Wichita 2 Kans
Danforth Drlg Co 418 Kennedy Bldg Tulsa Okla
Darden R W Drlg Co Box 576 Olney Tex
Davidson Drlg Co Inc 1004 Continental Life Bldg Ft Worth Tex
Davis & Bates Inc 1724 Milam Bldg San Antonio 5 Tex
Edgar Davis Drlg Co 717 Citizens Natl Bk Bldg Abilene Tex
H Davis & R H Thompson Co Calif
Davon Drlg Co Box 1586 Oklahoma City 9 Okla
Delaney M J Co 910 Dallas Fed Savings Bldg Dallas 1 Tex
Delta Drlg Co Box 2012 Tyler Texas
Delta Marine Drlg Box 2012 Tyler Tex
Dyer Drlg Co Box 338 Casper Wyo
Dillard-Waltermire Inc 109 Oil & Gas Bldg Houston 2 Tex
Dillier W L Box 205 Casey Ill
Dirickson-Lewis Drlg Co Philtower Bldg Tulsa Okla
Dixie Drlg Co Inc 2715 Mercantile Bank Bldg Dallas Tex
Dixilyn Corp Box 3427 Odessa Tex
Donnell Drlg Co Box 1308 Odessa Tex
Drlg & Expl Co of Del Inc Box 35366 Dallas 35 Tex
Drlg & Prod Co 2907 L St Bakersfield Calif
Dual Drlg Co 606 City Natl Bk Bldg Wichita Falls Tex
Dudley & Heath Drlg Co Box 428 Stillwater Okla
Durham Drlg Co Inc Box 204 Midland Tex

E

Eakle & Holder Drlg Co 116 Mulberry St Evansville Ind
Eason T T Co Div of Eason Oil Co Box 9755 Oklahoma City 18 Okla
Edman Drlg Co San Jacinto Bldg Houston Tex
Eggleston A W INC Box 425 Crowley La
Empire Drlg Co 650 Fourth Natl Bk Bldg Wichita 2 Kans
Empire States Drlg Corp 1020 Simms Bldg Albuquerque N M
Ewing Drlg Co Box 807 Breckenridge Tex
Exeter Drlg Co 919 Midland Svgs Bldg Denver Colo

F

FWA Drlg Co Inc 300 1st Natl Bank Bldg Wichita Falls Tex
Fairman Drlg Co Hammersley Fork Pa
Falco Drlg Co Inc Box 1255 Alice Tex
Falcon Seaboard Drlg Co Pan American Bldg Tulsa Okla
John O Farmer Inc Box 352 Russell Kans
Fitzpatrick Drlg Co 803 Wilson Tower Corpus Christi Tex
Fitzpatrick Drlg Co Inc Box 639 Casper Wyo
Foree Drlg Co 607 First Natl Bk Bldg Dallas 2 Tex
Fortenbery Drlg Co Inc Box 273 Natchez Miss
Fortune Drlg Corp Petroleum Bldg San Angelo Tex
Armstrong Fowler Inc 929 Oleander Bakersfield Calif
Frizzell Drlg Co 108 W Main St Oklahoma City Okla

G

Gardner Bros Drlg Co Inc 1718 Davis Bldg Dallas Tex
Garr-Woolley Oil Co 901 Cravens Bldg Oklahoma City Okla
Garvey Drlg Co Route 2 Great Bend Kans
Gateway Petroleum Co Inc 723 Southland Center Dallas Texas
General Well Drlg Inc Box 1315 Alice Tex
Gilchrist Drlg Co Box 469 Abilene Tex
Glenn Gillespie & Sons Inc Box 907 Cushing Okla
Glenn Drlg Co 38 Kennedy Bldg Tulsa Okla
Gober F E Drlg Co 3032 Cherry Ave Long Beach 7 Calif
Goff-Leeper Drlg Co Box 1749 Ardmore Okla
Gore Drlg Co Box 515 Albany Tex

Grace H O Drlg Co 632 Wichita Natl Bldg Wichita Falls Tex
Grace Jack Drlg Co 1009 City Natl Bldg Wichita Falls Tex
Gracey-Hellums Corp 410 S Coast Bldg Houston 2 Tex
Graham Drlg Co 2nd Floor First St Bk Bldg Temple Okla
Grannell Drlg Co Box 583 Casper Wyo
Grappe John Drlg Co Box 1186 Levelland Tex
Goll Graves & Mechling Inc 205 Bearinger Bldg Saginaw Mich
Great Northern Drlg Co Inc P O Box 1953 Billings Mont
Great Western Drlg Co Box 1659 Midland Tex
Grey-Wolf Drlg Co 1506 Bk of the Southwest Houston 2 Tex
Gross Drlg Co 1124 Douglas Rd Eldorado Kans
Guadalupe Drlg Co 2505 Princeton Ave Midland Tex
Guffey Roy Drlg Co 5543 Yale Blvd Dallas 6 Tex
Gulley, Long & Hedge Drlg Co Inc Box 567 Laird Hill Rd Kilgore, Tex
Gwaltney Henry Drlg Co Box 289 Washington Ind

H

H & S Drlg Co 407 Tri State Ins Bldg Tulsa Okla
Hack Drlg Co Box 5108 Abilene Tex
Hagestad John S Drlg Co 3224 Gulf St Bakersfield Calif
Halbert Drlg Co 607 Citizens Bk Bldg Tyler Tex
Hall Clyde Drlg Co Inc Box 4068 Bakersfield Calif
Hall O E Drlg Co 2008 Continental Natl Bk Bldg Ft Worth 2 Tex
Hamman Oil & Ref Co Box 13028 Houston 19 Tex
Haney & Williams Drlg Co 3500 Cherry Ave Long Beach 7 Calif
Harkins & Co Box 1490 Alice Tex
Harper-Turner Drlg Co 904 Hightower Bldg Oklahoma City Okla
Harris John W Drlg Co 525 Wichita Natl Bk Bldg Wichita Falls Tex
Hatcher H F & Son Drlg Co Box 447 Smackover Ark
Helmerich & Payne Inc First Natl Bldg Tulsa Okla
Hayward Drlg Co Box 295 Enid Okla
The Herb Expl Co 342 Lexington Ave Abilene Tex
Herndon Drlg Co Drawer 489 Tulsa Okla
Herring Maxwell Drlg Corp 619 Citizens Bk Bldg Tyler Tex
Highland Drlg Co Box 671 Odessa Tex
Highland Oil Box 263 Jasper Ind
Hinton W B 2900 Mercantile Bk Bldg Dallas 1 Tex
Holliman Drlg Co 712 Fidelity Union Life Bldg Dallas Tex
Holm Drlg Co Box 7246 Tulsa 18 Okla
Holmes Drlg Co 1045 San Jacinto Bldg Houston Tex
Holt Brothers Drlg Co Box 236 Pampa Tex
Hondo Drlg Co Box 116 Midland Tex
Hose-Austin Drlg Corp Box 1067 Casper Wyo
Houchins Drlg Co Box 388 Mt Carmel Ill
M L Houston Drlg Co 616-4 1st Wichita Nat Bank Bldg Wichita Falls Texas
Houston Oil Well Serv Co 504 Waugh Dr Houston 19 Tex
H H Howell 604 Milam Bldg San Antonio Tex
Hull Oil Co 203 Panhandle Bldg Wichita Falls Tex
Hulton Drlg Co 308 Brink Dr Bakersfield Calif
Hydro Drlg Co Inc 788 Petroleum Bldg Tyler Tex

I

Indian Drlg Co 817 Ritz Bldg Tulsa Okla
Ingling Donald T 623 First Natl Bk Bldg Wichita 2 Kans

J

J & C Drlg Co 311 Citizens Standard Bldg Corpus Christi Tex
J & C Drlg Co Box 216 Refugio Tex
Jack S W Drlg Co Allegheny Ave Avonmore Pa
Jackson A L Drlg Co Box 194 Great Bend Kans
Jennings Drlg Co (Alberta) Ltd 528-8 AveW Calgary, Alberta, Canada
Jet Drlg Co Inc 304 California Bldg Denver 2 Colo
Geo H Jett Drlg Co Box 1832 Shreveport La
John Drlg Co 711 Fair Bldg Ft Worth 2 Tex
Fred Johnson Drlg Co 2790 Cherry Ave Long Beach 6 Calif
Johnson-Bates Drlg Co Box 425 Konawa Okla
Jonco Drlg Co Box 1214 Seminole Okla
Jones Woody Drlg Co 408 E Main St Olney Ill
Justiss-Mears Oil Co Inc Box 396 Jena La

K

K & E Drlg Inc 719 Union Center Bldg Wichita 2 Kans
Keating-Parker Drlg Co 510 Natl Bk of Tulsa Bldg Tulsa 3 Okla
Kellogg K L & Sons 3777 Long Beach Blvd Long Beach 7 Calif
Kelly Drlg Co Inc Box 1126 Houma La
Kendall-Davis Drlg Co Inc 201 S E 1st St Evansville Ind
Keoughan Drlg Co Inc Box 12246 Ft Worth Tex
Kern Drlg Co Inc Box 699 Magnolia Ark
Kerr-McGee Oil Industries Inc Kerr-McGee Bldg Oklahoma City Okla
King-Phillips Inc 1108 Continental Natl Bk Bldg Ft Worth Tex
Kingery Drlg Co Inc Box 97 Saint Jo Tex
Kirby Oil Ind Inc Box 1757 Benson Station Omaha 4 Neb
Kirk Drlg Co 715 First Perry Okla
Kirkpatrick Oil Co 1300 N Broadway Okla City Okla
Knight Drlg Co Box 1332 Bakersfield Calif
A J Kuenstler Drlg Co Box 1374 Alice Tex
Kullberg & Otthouse Inc Box 967 Cut Bank Mont

L

L & F Drlg Co Box 1468 Bakersfield Calif
L & N Drlg Co Box 8057 6709 Canal Blvd Shreveport La
H T Porter Drlg Co Petroleum Life Bldg Midland Tex
Leatherwood Drlg Co Box 925 Jacksboro Tex
Lee Drlg Co 1007 Philtower Bldg Tulsa Okla
Le Mans Drlg Co 310 U S Natl Centr Bldg Denver 2 Colo
D B Lesh Drlg Co Box 505 Mattoon Ill
Lewis Bros Inc 310 U S Natl Center Bldg Denver 2 Colo
Lewis Will I Drlg Co 207 Continental Oil Bldg Denver Colo
Lindsey M M Drlg Co Box 3055 Baton Rouge La
Lindsay, Ted Box 190 Mt Vernon Ill
Lin-Mour Drlg Co 1112 Oil & Gas Bldg Wichita Falls Tex
Llano Drlg Co 301 V & J Tower Bldg Midland Tex
Lohmann-Johnson Oil Co Inc 320 Indiana Bk Bldg Evansville Ind
Longhorn Drlg Corp Box 546 Three Rivers Tex
Love-Miller Drlg Co Inc 712 Patterson Bldg Denver 2 Colo
Low Drlg Co Box 1112 Cisco Tex
Lowe Drlg Co Box 832 Midland Tex
Lunsford Drlg Co 505 Louisiana Bk Bldg Shreveport La
Lynn Drlg Co 1403 Natl Bk of Tulsa Bldg Tulsa Okla

Mc

McCall Gabe Drlg Co Box 2068 Casper Wyo
McCutchin Gene Drlg Co Box 1585 Dallas 21 Tex
J W McCutchen Drlg Co 409 Oil & Gas Bldg Wichita Falls Tex
McDonald Drlg Co 1409 Garden City Hwy Midland Tex
McGoldrick & Watson Drlg Co 405 Beck Bldg Shreveport La
M-H-O Drlg Co Box 297 Cut Bank Mont

M

Mac Drlg Co Box 2972 Houston 1 Tex
Mallard Drlg Co 1016 Union Natl Bk Bldg Wichita Kans
Man Drilling Co 200 City National Bank Bldg Wichita Falls Tex
Mangum Drlg Co 834 Esperson Bldg Houston 2 Tex
Manning R L Co 318 Continental Oil Bldg Denver Colo
Maritzky & Bibby Box 509 Homer La
M L (Mike) Marrs Drlg Co Box 985 Drumright Okla
Lubie Martin Drlg Co 2052 Harvard Houston Tex
Meadows & Walker Drlg Co 500 San Jacinto Bldg Houston 2 Tex
Melco Drlg Co Box 1360 Seminole Okla
Mendenhall Drlg Co Box 650 Emporia Kans
Mesker Drlg Co Box 7465 Tulsa 5 Okla
Midwestern Drillers Inc 1206 Mid-Continent Bldg Tulsa 3 Okla
Milam Drlg Co 1814 Alamo Natl Bldg San Antonio Tex
Miller & York Box 1664 Bakersfield Calif
Gene Miller Inc Box 238 Lawrenceville Ill
Miller Bros & Bowling Box 611 Alice Tex
Monte Christo Drlg Corp Box 1780 McAllen Tex
Montgomery J S 103 NW 44th St Oklahoma City 18 Okla
Montgomery Drlg Co Box 747 El Dorado Ark
R B Montgomery Drlg Inc P O Box 1102 Bakersfield Calif
Moran Bros Inc 1200 Oil & Gas Bldg Wichita Falls Tex
Moran E W Drlg Co 500 First Natl Bk Bldg Wichita Falls Tex
Moran Oil Prod & Drlg Corp Box 1718 Hobbs N Mex
Morris Pete Drlg Co Box 733 Ada Okla
Mount Dale Drlg Inc 1155 Mercantile Dallas Bldg Dallas 1 Tex
Mountain States Drlg Co Inc 622 Patterson Bldg Denver 2 Colo
Murfin Drlg Co 617 Union Center Wichita 2 Kans

N

Neal Drlg Co 1507 Esperson Bldg Houston 2 Tex
Nemaha Oil Co 2206 Mercantile Bk Bldg Dallas Tex
Newton Drlg Co Box 1104 Coalinga Calif
Nichols Drlg Co Box 1032 Duncan Okla
The Noah Petroleum Co 23 Main St Evansville 8 Ind
Norman Drlg Corp 1141 Butternut St Abilene Tex
Norton Drlg Co 542 Natl Bk of Commerce New Orleans 12 La
Norwood Drlg Co 700 Wichita Natl Bk Bldg Wichita Falls Tex

O

O'Brien Davey Drlg Co Inc 615 Ft Worth Club Bldg Ft Worth Tex
Oien Oil Corp Box 2235 Cut Bank Mont
Oliver E L Drlg Co Box 103 Oklahoma City Okla
Omohundro W B Box 774 Wichita Falls Tex
O'Neal-Garvin Drlg Co Box 1289 Duncan Okla
Oney Drlg Co Box 425 Graham Tex
Oxford Drlg Co Box 787 Albany Tex

P

Parker Drlg Co 418 Natl Bk of Tulsa Bldg Tulsa 3 Okla
Pease Willard Drlg Co Box 1532 Grand Junction Colo
Pecos Drlg Co Box 798 Artesia New Mex
Penrod Drlg Co 1320 Mercantile Securities Bldg Dallas 1 Tex
Pep Drlg Co 1002 Main St Mt Vernon Ill
Perkins Drlg Co Box 1232 Duncan Okla
Peters Drlg Co American State Bank Bldg Great Bend Kans
Petro Drlg Co Inc Box 339 Mt Vernon Ill
Pico Drlg Co Box 512 Breckenridge Tex
Pioneer Drlg Co Inc Box 2211 Casper Wyo
Pool Fred Drlg Co 908 Petr Life Bldg Midland Tex
The Power Rig Drlg Co Inc Box 1436 OCS Lafayette La
Prairie Drlg Co Inc Box 2068 Casper Wyo
Prime Drlg Co 814-16 Union Center Wichita Kans
Producers Drlg Co Inc 927 Natl Bk of Commerce Bldg New Orleans La
Pyburn Drlg Co Box 4276 Shreveport La

R

R-G Drlg Co 403 City Natl Bk Bldg Wichita Falls Tex
R W I T Drlg Co Box 551 Holdenville Okla
Raiborn Drlg Co 35 Garden Rd San Angelo Tex
Raymond Oil Co Inc 410 4th Natl Bank Bldg Wichita 2 Kans
Rayna Drlg Co Natl Bk Bldg Houston Tex
Reading & Bates Inc 1101 Philtower Bldg Tulsa 3 Okla
Reed Drlg Co Inc 1209 Atlas Bldg Tulsa Okla
Rex & Morris Drlg Co Box 334 El Dorado Kans
Rheay & Reynolds Drlg Co 404 Petroleum Bldg Abilene Tex
Rhodes & Hicks Drlg Corp Box 1395 Alice Tex
Rimrock Tidelands Inc Box 896 New Orleans La
Rine R W Drlg Co 420 Union Center Bldg Wichita Kans
Roberson C M Drlg Co 1201 Petroleum Tower Shreveport La
Robinson Bros Drlg Co Box 430 Borger Tex
Robinson Drlg Co Box 970 Colorado City Tex
Rocket Drlg Co 2099 E 27th St Long Beach 6 Calif
Rocky Mountain Drlg Co 6790 N Ventura Ave Ventura Calif
Ross R Benton Inc 403 Robertson Bldg Wichita Falls Tex
Rowan Drlg Co Inc Drawer 12247 Ft Worth 16 Tex
Ruhl Drlg Co Inc 1621 Bk of Southwest Bldg Houston 2 Tex
Rutledge Drlg Co Box 2239 Santa Fe N Mex

S

Salt Dome Prod Co 737 Texas Natl Bk Bldg Houston 2 Tex
Santa Fe Drlg Co Box 310 Whittier Calif
Santa Rosa Drlg Co Box 633 Apple Valley Calif
Schlaikjer A L Box 761 Newcastle Wyo
Schoenfeld-Hunter-Kitch Drlg Co 812 Kennedy Bldg Tulsa 3 Okla
Scooter's Drlg Serv 437 Fortson Shreveport La
Sea Drlg Co 809 Whitney Bldg New Orleans La
Seran & Howard Drlg Co Box 110 Okemah Okla
SeRoBee Drlg Co Inc 5301 N Broadway Wichita Kans
Service Drlg Co 1307 S Boulder Tulsa Okla
Shaw-Hughes Drlg Co Box 1108 Bristow Okla
Sherin Drlg Co Inc 1709 First Natl Bldg Oklahoma City Okla
Shields Drlg Co Inc Box 709 Russell Kans
Shulman Bros Box 191 Vandalia Ill
Signal Drlg & Explo Inc 415 Petroleum Club Bldg Denver Colo
Simpson C J Drlg Co P O Box 10345 Dallas 20 Tex
Simpson CR Drlg Co 2975 Wilshire Blvd Los Angeles 5 Calif
Sitton & Norton Drlg Co 406 Lubbock Natl Bk Bldg Lubbock Tex
Slape Don Drlg Co Box 432 Olney Ill
Slats Honeymoon Drlg Co 1416 Liberty Bank Bldg Oklahoma City Okla
Slim Rea Drlg Co 2712 US 41 So Vincennes Ind
Smiley Drlg Co Rt No 1 Box 241 Moore Okla
Smith K Cable Tools 1801 Van Buren Great Bend Kans
Smith Ray Drlg Co 305 Simons Bldg Dallas Tex
Sojourner Drlg Corp Box 679 Abilene Tex
Southeastern Drlg Corp 211 N Ervay St Dallas Tex
Spradling Drlg Co 401 N Cedar Borger Tex
Sprecher J D Box 299 Casper Wyo
Star Drlg Inc P O Box 1078 Farmington N Mex
Steen Drlg Co 619 West Bldg Houston 2 Tex
Sterling Drlg Box 125 Sterling Colo
Stickle Drlg Co 1100 Bitting Bldg Wichita 2 Kansas
Storm Drlg Co 1512 Wilson Tower Corpus Christi Tex
Stouder Drlg Co 208 SE Riverside Dr Evansville Ind
Strain Drlg Co Box 157 Port Huron Michigan
Sun Drlg Co The 2975 Wilshire Blvd Los Angeles 5 Calif
Sunflower Drlg Co Box 311 Eureka Kan
Sunnyland Contr Co Inc Box 388 Rayne La
Sutton Drlg Co Box 6446 San Antonio Tex
Symons Drlg Co 999 Houston Club Bldg Houston 2 Tex

T

T & H Corp 111 N 7th St Terre Haute Ind
Taylor Expl Co Inc 2118 Welch Ave Houston 19 Tex
Temple Drlg Co Inc 320 Indiana Bk Bldg Evansville Ind
Terminal Drlg & Prod Co P O Box 607 Wilmington Calif
Texas Drlg Co Box 505 Monahans Tex
Texdrill Corp McClain-Williams Bldg Conroe Tex
Tex-Mex Drlg Co 1211 Fidelity Union Life Bldg Dallas Tex
Thomas & Saxon Drlg Co 809 Citizens Natl Bk Bldg Abilene Tex
Thompson Expl Drlg Co Box 1657 Lubbock Tex
Thrasher Drlg Co Inc 1602 Beck Bldg Shreveport La
Thunderbird Drlg Inc 712 Union Center Bldg Wichita 2 Kan
Trachta Drlg Co Box 67 Muenster Tex
Tradewinds Drlg Co National Bank of Tulsa Bldg Tulsa 3 Okla
Transit Corp 1516 Liberty Bk Bldg Oklahoma City Okla
Trant Drlg Co 1201 Peoples Natl Bank Tyler Tex
Tri-Service Drlg Co Box 1785 Midland Tex
Trio Drlg Co 3012 Nussbaumer St Dallas 26 Tex
Troop Drlg Co Box 145 St Elmo Ill
Troup & Suttles Inc Box 356 Konawa Okla
True Drlg Co Drawer 1612 Casper Wyo
Tucker Drlg Co Box 1876 San Angelo Tex

U

U & E Drlg Co Box 323 Sullivan Ind
Unit Drlg Co Box 599 Bristow Okla

V

Viersen & Cochran Box 280 Okmulgee Okla
Viking Drlg Co 102 W Crockett St San Antonio 5 Tex
John W Voss Drlg Co Inc 1322 Highland Dr McAllen Tex

W

Wade Drlg Co Inc 813 Gulf Bldg Tulsa Okla
Wagner & Wyant Drlg Co Inc 414 Petroleum Bldg Amarillo Tex
Wakefield Earl F 515 Union Center Bldg Wichita Kans
Walters Drlg Co Inc 4114 McMillan Dallas 6 Tex
Walters Rusty Drlg Co Box 304 Bakersfield Calif
Walton Drlg Co Box 241 Fairfield Ill
Ward Tommy Drlg Co 2402 Liberty Bk Bldg Oklahoma City Okla
Warton Drlg Co Box 2807 Odessa Tex
Carnes W Weaver Drlg Co 326 Gulf Bldg Houston Tex
Webster C. B. Drlg Co 609 San Jacinto Bldg Houston 2 Tex
Well Drillers Inc 2001 First City Natl Bk Bldg Houston Tex
Wentworth Claude Drlg Inc Box 588 Russell Kan
Wes-Tex Drlg Co Box 2058 Abilene Tex
Westfall Chester H Drlg Co 1612 First Natl Bk Bldg Tulsa Okla
Wheless Drlg Co Box 1746 Shreveport La
Wilson Fred Drlg Co 1604 Beck Bldg Shreveport La
Woolf & Magee Inc Box 635 Tyler Tex

Y

Yarborough Drlg Co 735 Wilson Bldg Corpus Christi Tex
Yates S P Drlg Co 309 Carper Bldg Artesia N Mex
Young Marshall R. Drlg Co Drawer 712 Brookhaven Miss

U. S. Contract ROTARY Drilling Rigs

Asterisk (*) indicates rig also available for workover.

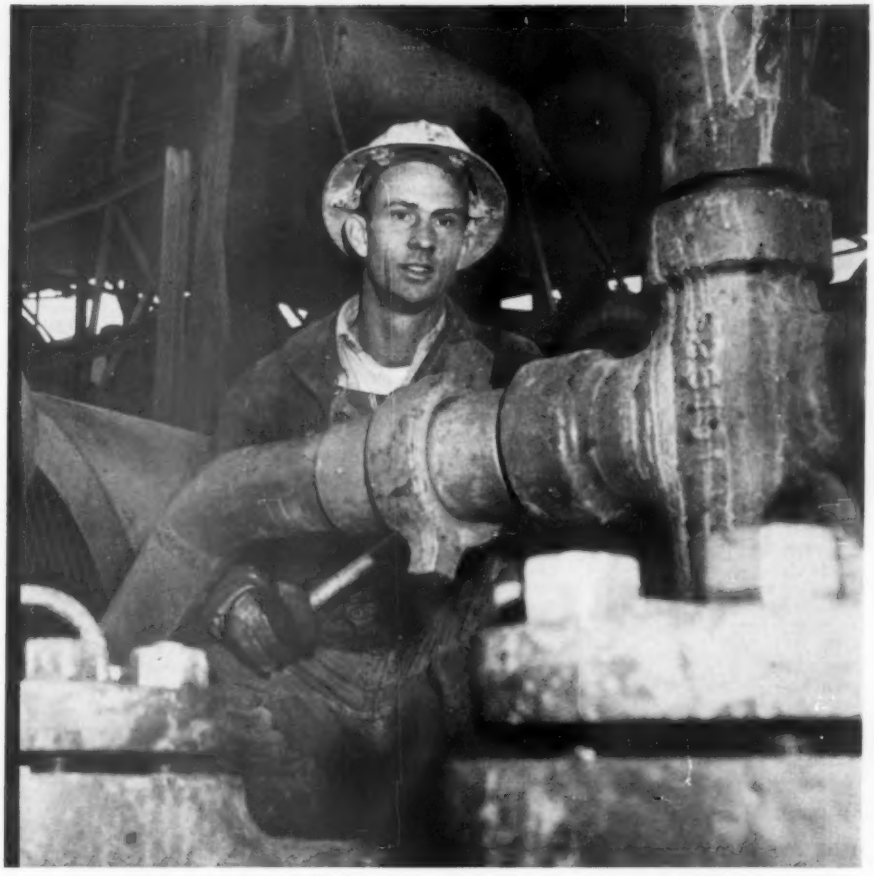
Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
ALABAMA						
Mobile County						
Geo H Jett Drlg Co	110	dsl	1400	Brwstr N-95	1400	14,000
	111	dsl	2000	Natl 110	1500	15,000
ALASKA						
Miller & York Inc	11	dsl	300	Emsco GA 250	300	5,500
Bethel County						
Rowan Drlg Co Inc	27	dsl	1545	Nat'l 125	1545	20,000
Big Lake						
Coastal Drlg Co		dsl	1200	Emsco G-500	800	9,000
Caroc Bay						
Reading & Bates Drlg Co Ltd	2	dsl	1000	NSCO 55	1000	13,000
Kenai Peninsula						
Coastal Drlg Co	3	dsl	1000	Emsco A-800	1650	13,000
	4	gas	1000	Emsco GB-800	1050	12,000
	5	dsl	1950	Emsco GB-800	1300	14,000
	6	dsl	1125	Emsco G-500	750	9,000
Reading & Bates Drlg Co		dsl	1800	Natl 80B	1800	12,000
		dsl	2000	Natl 110	2000	20,000
	6	dsl	12,000	NSCO 80B	12,000	14,000
Rowan Drlg Co		gas	1350	Natl 110	2025	16,000
	29	gas-btne	1950	Natl 110	1950	16,000
	33	dsl	1685	Natl 125	1685	18,000
Pavlov Bay						
Reading & Bates Drlg Co		dsl		Natl 55		12,000
Yakataga						
Clyde Hall Drlg Co Inc	9	dsl	2000	Natl 110	2000+	16,000
ARKANSAS						
Columbia County						
Montgomery Drlg Co	2	gas-btne	415	Brwstr N-55		7,500
Thrasher Drlg Co Inc	1	gas-btne	600	M-CSCO U-15	800	9,000
Saline County						
Walters Drlg Co Inc	8	gas	220	Mayhew 1000	220	600/2⅛"
Sebastian County						
Falcon Seaboard Drlg Co	16	gas	480	M-CSCO U-15	480	8,500
	20	gas	400	M-CSCO U-15	450	7,000
Union County						
H F Hatcher & Son	2	gas-gaso	250	Crdwll S-350	225	5,500
M Houston Drlg Co	1	gas	700	Wisn Gnt	700	10,000
Yell County						
Service Drlg Co	16	gas or air	1600	Wisn Spr Titan	1600	18,000
CALIFORNIA						
Colusa County						
Brown Drlg Co	*3	dsl	825	"Oilwell" 66	550	9,500
	*4	dsl	1200	Natl 80B	1200	12,500
John S Hagestad Drlg Co	1	dsl	570	Emsco GB-350	400	7,000
Contra Costa County						
L & F Drlg Co	3	gas-dsl	1000	Natl 75		9,800
Fresno County						
John S. Hagestad Drlg Co	4	dsl	680	Ideco H-525	440	7,500
Miller & York Inc.	C	dsl	550	Emsco GB-350	450	7,500
R B Montgomery Drlg Inc	*5	gas	1300	Natl 75	1050	11,000
Glenn County						
Brown Drlg Co	*7	dsl	900	Natl 50CA	600	9,000
Kern County						
Barnes Core Drlg Co	D-6	dsl	450	Custom	450	5,500/3½"
	D-10	dsl	450	Custom	450	5,500/3¼"
H Davis & R H Thompson Co	1	dsl	350	Emsco G-300	350	6,000
Drlg & Prod Co	1	dsl	400	Crdwll	350	6,000
	2	dsl-gas-gaso	400	Crdwll O	432	6,000
Coastal Drlg Co	1	dsl	3000	Emsco J-1250	1920	16,000
	2	gas	1200	Emsco J-750	1320	11,000
Armstrong Fowler Inc	2	dsl	300	Natl T-12	250	3,000
John S. Hagestad Drlg Co	3	dsl	625	Emsco GB-350	400	7,000
Haney & Williams Drlg Co	3	gaso	750	Natl 75	1050	10,000
	*5	gas	1500	Wisn Titan	1000	12,500
Hulton Drlg Co	*1-T12	LP gas	350	Natl T12	225	3,500
	*2	LP gas	200	Wisn Dr	100	2,000
K L Kellogg & Sons	18	gas	925	Natl 50	650	7,000
	19	dsl	1200	Natl 75	790	9,500
	25	dsl	1480	Natl 75	1480	9,500
	28	dsl	1350	Natl 100	1100	13,000
	33	gas	1750	Emsco GB-800	1050	12,000
	34	gas	2475	Natl 125	2475	16,000
Knight Drlg Co	1	dsl	820	M-CSCO U-35D	500	8,000
	2	dsl	1380	Natl 50-CA	720	9,000
	3	gas	1450	Beth M-58	1000	11,000
L & F Drlg Co	1	gas	300	Emsco GB-250		5,000
Miller & York Inc	1	dsl	300	Franks Gnt Clip	225	4,000
	G	dsl	300	Emsco G-36	300	5,500
	J	dsl	300	Hopper MTA	325	5,500
R B Montgomery Drlg Inc	*1	dsl	1617	Natl 130	1635	18,000
Newton Drlg Co	1	dsl	350	Ideco	350	4,000
	2	dsl	600	Ideco	350	5,000
Rocky Mountain Drlg Co	9	gas	1500	Natl 125	1500	20,000
	10	dsl	1850	Emsco J-1000	1850	15,000
	14	gas	1500	Emsco J-1250	1500	20,000
Sun Drlg Co	*3	dsl	1300	Natl 110	1950	16,000
	*5	gas	1530	Natl 110	1530	16,000
Kings County						
K L Kellogg & Sons	27	gas	2000	Natl 100	1050	13,000
R B Montgomery Drlg Inc	*2	gas	1350	Natl 110	2025	16,000
Los Angeles County						
Camay Drlg Co	4	gas	1400	Emsco GA-500	750	9,000
	5	gas	700	Natl 50	550	7,500
	6	gas	700	Natl 50	550	7,500
Drlg & Expl Co of Del Inc	20	gas-gaso	1200	Natl 110	900	13,500
	31	gas-gaso	1500	Natl 130	1200	18,000
	43	gas	950	Emsco GB-800	1000	12,000
F E Gober Drlg Co	*2	gas	450	Natl 50A	450	7,000
	*3	dsl	450	Ideco 700	600	8,000
John S. Hagestad Drlg Co	2	dsl	540	Ideco H30-D	340	4,500
Haney & Williams Drlg Co	*1	dsl	300	Wisn Gnt	300	5,000
	*2	gas	600	Natl 50	600	7,500
Fred Johnson Drlg Co	1	gas	1071	Wisn Titan	714	9,500
	3	gas	1500	Emsco J-1000	1125	12,500
	4	DC elec	1450	Emsco J-1000	1200	12,500
K L Kellogg & Sons	29	gas	1370	Natl 75	700	9,500
	31	gas	1580	Natl 125	1050	16,000
	32	gas	1400	Natl 75	1050	9,500
Rocket Drlg Co	1	gas-btne-pro	555	Emsco G-300	350	5,500
Rocky Mountain Drlg Co	12	gas	1850	Natl 125	1850	20,000
Santa Fe Drlg Co	25	gas	1200	Natl 55	900	10,000
	26	gas	1200	Wisn Titan	900	10,000
	28	gas	1200	Natl 80-B	1350	12,000
	29	elec	1000	Natl 3410½ FE	800	15,000
C R Simpson Drlg Co	1	gas	700	Natl 50	432	7,000
Sun Drlg Co	1	gas	2430	Natl 125	2430	20,000
	*2	elec	850	Natl 110	500	11,000
	*4	elec	850	Natl 110	500	11,000
Terminal Drlg & Prod Co	*4	gas	630	Ideco H-40-D	450	6,000
	*7	dsl	330	Howard-Turner mm-1000	120	2,500
	*8	dsl	480	Wisn Mogul	350	5,000
Merced County						
Miller & York Inc	A	dsl	550	Emsco GC-500	900	10,000
Morgan County						
Le Mans Drlg Co	6	dsl	275	Crdwll J-350	225	6,500
Orange County						
Camay Drlg Co	1	gas	2295	Emsco J-1000	1425	13,000
H Davis & R H Thompson Co	2	dsl	350	Emsco GA-250-T	350	6,000
C R Simpson Drlg Co	2	gas	700	Natl 50	520	8,000
Terminal Drlg & Prod Co	*5	dsl	490	Ideco H-40-D	400	5,000
	*12	gas	320	Ideco H-30	190	4,000
Sacramento County						
Newton Drlg Co	4	dsl	700	Emsco	350	6,000
Rusty Walters Drlg Co	1	dsl	360	Cooper D-50	360	6,000
	2	dsl	360	Wisn Torcair	360	7,000
Brown Drlg Co	*6	dsl	1600	Natl 110	2400	16,000
San Benito County						
Hulton Drlg Co	3	dsl	200	Gen Mach	125	3,000
San Bernardino County						
Santa Rosa Drlg Co	1	prop-gas	155	Shop made 1950	285	2,000
San Joaquin County						
Brown Drlg Co	*2	dsl	825	"Oilwell" 66	550	9,500
	*9	dsl	825	Natl 50-CA	500	9,000
L & F Drlg Co	2	dsl	500	Emsco GB-250	—	5,000
San Luis Obispo County						
K L Kellogg & Sons	23	gas	2090	Natl 75	790	9,500
Miller & York Inc	F	dsl	550	Emsco GA-500	600	8,500
Santa Barbara County						
Haney & Williams Drlg Co	A	AC elec	1400	Natl 80-B	1200	13,000
	B	dsl	1600	Natl 80	1600	13,000
	C	AC elec	1400	Natl 80-B	1200	13,000
Sonoma County						
Barnes Core Drlg Co	D-11	dsl	225	Custom	225	3,000/3½"

WECO FIG. 100
1000 psi Test
Sizes: 2" through 8"

WECO FIG. 200
2000 psi Test
Sizes: 1" through 10"

WECO FIG. 400
4000 psi Test
Sizes: 2" through 12"

WECO FIG. 602
6000 psi Test
Sizes: 1" through 4"



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WE RIG UP FASTER NOW!

WECO Ball and Cone Seat Unions seal under the toughest conditions. Strong, acme threads on female sub and nut make-up fast. Forged, heat-treated nuts take punishment that ruins ordinary wing nuts.

WECO UNIONS ALWAYS MATCH BY SIZE AND PRESSURE RATING . . . WHEN RIGS ARE STANDARDIZED WITH WECO UNIONS NO TIME IS LOST IN UNNECESSARY SHIFTING OF RIG COMPONENTS OR CHANGING UNIONS TO GET MATCHING SETS.

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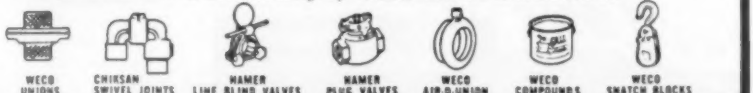

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Avail-able to Drwwks	Rated Depth with 4½" Pipe
Sutter County						
Armstrong Fowler Inc	3	dsl	—	Wisn Mogul	—	5,000
Newton Drlg Co	5	dsl	700	Emsco GA-500	700	9,000
Santa Fe Drlg Co	3	gas	900	Emsco G-500	440	7,500
	32	dsl	450	Ideco H-40	300	6,000
Ventura County						
Caldrill Inc	T	gas	1600	OWS 96	1400	16,000
	U	gas	1500	OWS 96	1600	16,000
Camay Drlg Co	8	dsl	1900	Emsco A-800	1900	13,000
Clyde Hall Drlg Co Inc	5	gas-btne	1000	Emsco GB-800	1000	12,000
Drlg & Expl Co of Del Inc	29	gas-gaso	1500	Natl 34-10	1200	18,000
K L Kellogg & Sons	7	gas	2240	Natl 100	1050	13,000
	36	gas	2475	Natl 125	2475	16,000
Rocky Mountain Drlg Co	1	gas	1200	Natl 75	900	11,000
	2	gas	1200	Natl 75	900	11,000
	3	gas	1200	Natl 100	900	14,000
	4	gas-dsl	1550	"Oilwell" 96	1850	20,000
	5	gas	1850	"Oilwell" 96	1850	20,000
	6	gas	1550	Emsco J-1000	1550	15,000
	7	gas	1200	Natl 100	1110	15,000
	8	gas	1400	Natl 125	1750	20,000
	13	gas	1550	Emsco J-1250	1550	20,000
	15	gas	1200	Emsco J-750	900	11,000
Santa Fe Drlg Co	45	gas	900	Natl 100	1350	12,000
Terminal Drlg & Prod Co	*1	gas	990	Natl 50-A	700	8,500
	6	dsl	1000	Emsco GC-500	750	10,000
	*17	dsl	480	Wisn Mogul	350	5,000
	*18	dsl	600	Ideco 525	600	8,000
Yolo County						
Camay Drlg Co	9	gas	2775	Natl 130	2400	20,000
R B Montgomery Drlg Inc	*3	gas	1400	Natl 100	1050	12,000
	*6	dsl	1000	Natl 75	600	10,000
COLORADO						
Baca County						
K & E Drlg Inc	*3	dsl	225	Natl T-25	300	5,000
Doloris County						
Calvert Drlg Inc	28	gas-btne	1650	Natl 80-B	1650	12,500
Garfield County						
Gardner Bros Drlg Co Inc	9	gas-btne	450	M-CSCO U-15	675	7,000
Garland County						
Walters Drlg Co Inc (Dallas)	4	gas	130	Mayhew 1000	130	600/2⅞"
La Plata County						
Circle A Drlg Co Inc	2	dsl	600	Wisn Gnt	600	8,500
	4	gas	600	Wisn Gnt	650	8,500
Colorado & Western Drlg Co	1	dsl	1125	Natl 55	800	11,000
Logan County						
Garvey Drlg Co	12	dsl	300	Wisn Gnt	320	6,000/3½"
Lewis Bros Inc	2	dsl	450	M-CSCO U-15	550	8,000
Mesa County						
Arapahoe Drlg Co	4	gas-btne	375	Natl 50-A	680	8,000
Colorado & Western Drlg Co	2	dsl	600	Natl 50-A	600	8,000
	3	LP gas	225	Natl T-32	400	6,500
Mountain States Drlg Co Inc	4	gas-dsl	600	Emsco GB-500	—	9,000
Moffat County						
Camay Drlg Co Rocky Mt Div	1	gas	775	M-CSCO U-15	600	8,500
	6	dsl	260	Johnson	450	5,000
R L Manning Co	7	gas-btne	750	Emsco G-500	750	8,000
Signal Drlg & Expl Inc	6	gas-btne	1000	Natl 100	1000	13,500
Montezuma County						
Kerr-McGee Oil Industries Inc	4	gas	885	Natl 75	832	11,500
Morgan County						
Allison Drlg Co	1	gas	450	T-32	450	7,000
	2	gas	675	U-15	675	8,500
	4	gas	900	N-75	900	12,000
Rio Blanco County						
R L Manning Co	12	gas-btne	650	Emsco GA-350	450	7,000
Routt County						
Willard Pease Drlg Co	1	dsl	340	Stratmaster 90	320	5,500/3½"
San Miguel County						
Calvert Drlg Inc	29	dsl	1000	Natl 50-A	1000	10,000
Washington County						
Allison Drlg Co	5	gas	450	Frnks 137-DT	300	6,000
Exeter Drlg Co	2	btne	320	Emsco GA-250	250	6,000
Weld County						
Herndon Drlg Co	8	gas	600	Natl 50-A	750	10,500
GEORGIA						
Baldwin County						
Walters Drlg Co Inc (Dallas)	7	gas	175	Mayhew 1000	175	900/2⅞"
IDAHO						
Soda Springs County						
Walters Drlg Co Inc (Dallas)	5	gas-btne	—	Mayhew	100	500
ILLINOIS						
Champaign County						
W L Dillier Inc	2	gas	—	Failing 2500	130	2,000
Christian County						
U & E Drlg Co	*1	dsl	450	Frnks 4500	450	3,500
	*2	dsl	450	Natl T-12	450	4,500
Clark County						
W L Dillier Inc	4	gas	—	Failing 2500	130	2,000
Clay County						
Claypool Drlg Co	1	—	300	Natl T-12	185	3,500
W L Dillier Inc	5	dsl	—	Natl T-20	212	3,500
Woody Jones Drlg Co	1	dsl	240	M-CSCO U-34	230	4,500
Clinton County						
Conrey Drlg Co	1	gas	140	Wisn Super	140	2,000/3½"
Effingham County						
Ted Lindsay	3	dsl	220	Ideco H-30	160	4,000
Fayette County						
Troop Drlg Co	1	dsl	—	Natl T-20	220	4,500
Franklin County						
C E Brehm Drlg & Prod	3	dsl	302	Brwstr N-45	302	6,000
Gallatin County						
Kendall-Davis Drlg Co Inc	2	dsl	300	Crdwll S	300	4,000
Jefferson County						
Ted Lindsay	2	dsl	220	Natl T-16	220	5,000
Kankakee County						
Moran Bros Inc	14	dsl	350	Natl T-12	350	4,500
Lawrence County						
W L Dillier Inc	3	gas	—	Failing 2500	130	2,000
Slim Rea Drlg Co	3	dsl	300	Wisn Mogul	300	300
Marion County						
Conrey Drlg Co	2	dsl	175	Wisn Super	175	2,500/3½"
Richland County						
W L Dillier Inc	1	dsl	—	Natl T-12	212	3,000
Herndon Drlg Co	7	gas	409	Natl T-32	559	5,000
Don Slape Drlg Co	2	dsl	240	M-CSCO U-34	230	4,500
	4	dsl	300	Brwstr N-4	245	4,500
	5	btne	360	Natl T-12	260	4,500

Best Break Yet!

FOR DRILL COLLARS & TOOL JOINTS

Full string service from "Swivel to Bit."

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JET-LUBE INC

3093 NO. CALIFORNIA ST.
BURBANK, CALIF.

EXPORT OFFICE: 30 Rockefeller Plaza, New York 20, N. Y.

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Saline County						
Eakle & Holder Drlg Co	1	dsl	300	Brwstr N-4	200	5,500
Wabash County						
Big Seven Drlg Co	1	dsl	300	Emsco GB	300	4,500
Houchins Drlg Co	1	dsl	300	Natl T-20	300	4,500
Wayne County						
Pep Drlg Co	2	dsl	425	Ideco H-35	300	6,000
Petro Drlg Co Inc	1	dsl	450	Brwstr N-4	300	6,500
White County						
Herndon Drlg Co	5	gas	375	Brwstr N-4	375	4,500
	9	gas	240	Natl T-25	390	4,000
The Noah Petroleum Co	1	dsl	300	Brwstr N-4	300	5,500
Pep Drlg Co	1	dsl	425	Beth Breeze	300	5,000
Shulman Bros	1	dsl	330	Crdwll S-350	—	5,500
	2	dsl	330	Crdwll L	—	3,500
INDIANA						
Cass County						
Stouder Drlg Co	*2	dsl	310	Natl T-12	200	3,500
Gibson County						
Eakle & Holder Drlg Co	4	dsl	300	Natl T-20	300	5,500
Highland Oil Co Inc	—	gas	—	B-Erie	—	—
Lohmann-Johnson Drlg Co Inc	7	dsl	300	Crdwll S	440	4,500
Greene County						
Stouder Drlg Co	*1	gas	210	Natl 40	180	4,000
Knox County						
Henry Gwaltney Drlg Co	1	dsl	200	Natl T-12	165	3,000
	2	gas-prop	200	Crdwll	165	3,000
	3	gas	100	—	100	1,500
Posey County						
Burns Drlg Co	1	dsl	440	M-CSCO 15	440	7,500
Calvert Drlg Inc	12	dsl	260	Ideco H-30	260	4,500
Walton Drlg Co	1	gas	—	Failing 2500	—	2,000/3½"
Eakle & Holder Drlg Co	2	dsl	400	Emsco G-300	400	5,500
Kendall-Davis Drlg Co Inc	1	dsl	300	Wisn Mogul	300	4,000
T & H Corp	1	dsl	300	Emsco	250	6,000
Spencer County						
Walton Drlg Co	2	gas	—	Failing 2500	—	2,000/3½"
IOWA						
Dallas County						
Kirby Oil Ind Inc	—	dsl	400	Brwstr N-4	400	4,500
KANSAS						
Barber County						
Patton Drlg Co Inc	*2	dsl	450	Natl 50	450	6,500
Barton County						
Raymond Oil Co Inc	1	dsl	600	Wisn Torcair	600	4,500
Thunderbird Drlg Inc	1	btne	225	Crdwll Model S	225	4,500
Virginia Drlg Co Inc	*2	dsl	G D	Natl 50	400	7,000
Butler County						
Rex & Morris Drlg Co	1	dsl	260	Natl T-25	260	5,000
Cheynne County						
John O Farmer Inc	*5	gas	400	Natl 50	400	8,000
K & E Drlg Inc	*2	dsl	225	Natl T-20	300	5,000
Clark County						
Garvey Drlg Co	22	dsl	300	Wisn Mogul 42	450	7,000
Patton Drlg Co Inc	*1	gas	450	Natl 50	450	6,500
Earl F Wakefield	2	dsl	640	Wisn Gnt Rdair	640	8,500
Cowley County						
Mendenhall Drlg Co	1	dsl	300	Brwstr N-3	300	4,000/3½"
Claude Wentworth Drlg Co Inc	*1	gas	200	Crdwll "S"	200	5,000
Ellis County						
Murfin Drlg Co	2	dsl	300	Natl T-20	300	5,000
K Smith Cable Tools	*Wlkr-Nr	gas	—	S-32	140	4,800
Finney County						
Garvey Drlg Co	10	dsl	175	Wisn Gnt	296	5,000
Ford County						
Herndon Drlg Co	1	gas	409	"Oilwell" 64-B	559	6,000
Graham County						
Garvey Drlg Co	3	dsl	175	M-CSCO U-15	296	5,000
Hamilton County						
Earl F Wakefield	7	gas-btne	220	Emsco GB-160-T	250	4,500
Harper County						
Claude Wentworth Drlg Co Inc	*4	dsl	400	M-CSCO U-15	500	8,000
Haskell County						
Herndon Drlg Co	2	gas	600	Natl 50-A	750	10,500
Holm Drilling Co	5	dsl	440	"Oilwell" 52-T	260	6,000
Earl F Wakefield	3	dsl	440	Wisn Gnt Rdair	440	6,000
Hodgeman County						
Prime Drlg Co	3	dsl	275	Beth S-55	300	5,000
Kingman County						
Garvey Drlg Co	11	dsl	175	Wisn Gnt	296	5,000
Prime Drlg Co	2	dsl	300	Beth S-45	300	5,000
McPherson County						
Mallard Drlg Co Inc	*1	dsl	—	G-300	180	4,000
Marion County						
Barnett Drlg Inc	5	dsl	265	Natl T-25	265	5,000
Buick Drlg Inc	2	dsl	250	Wisn Gnt	325	5,000
Capitt Drlg Inc	5	gas	300	Beth FC-200	300	4,000
Se Ro Bee Drlg Co Inc	1	dsl	—	Crdwll K	150	4,000
Sunflower Drlg Co Inc	*1	dsl	175	Brwstr N-3	320	3,500
Meade County						
Bennett & Roberts Drlg Inc	*3	dsl	500	Emsco GA-500	500	8,000
Claude Wentworth Drlg Co Inc	*10	dsl	400	Emsco 500	500	8,000
Morton County						
Bennett & Roberts Drlg Co	*2	dsl	250	Emsco 250	250	6,000/3½"
Capitt Drilling Inc.	2	dsl	300	Beth S-45	285	5,000
Garvey Drlg Co	15	dsl	175	Wisn Gnt	296	5,000
Holm Drlg Co	4	dsl	520	"Oilwell" 52-T	520	6,000
Lohmann-Johnson Drlg Co Inc	8	dsl	300	Natl 32	550	7,500
R W Rine Drlg Co	4	dsl	620	Brwstr N-75	750	9,500
Norton County						
Bennett & Roberts Drlg Co	*1	dsl	250	Emsco GB-250	250	5,000
Garvey Drlg Co	9	dsl	175	Wisn Gnt	296	5,000
Phillips County						
K & E Drlg Inc	*1	dsl	225	"Oilwell" 52-T	300	5,000
Pratt County						
Kern Drlg Co Inc	*2	gas	350	Emsco 350	350	7,500
Reno County						
Gross Drlg Co	2	LPG	500	M-CSCO U-34	250	5,000
Rice County						
John O Farmer Inc	*4	dsl	400	Ideco H-30	400	7,000
Sterling Drlg Co	*4	gas	450	M-CSCO U-15	450	5,500
Rooks County						
Transit Corp	2	dsl	280	Emsco	—	4,500
	3	dsl	280	Emsco	—	4,500
	4	dsl	280	Emsco	212	4,500
Virginia Drlg Co Inc	*1	dsl	G D	Natl 32	400	5,000
Russell County						
A L Jackson Drlg Co	1	dsl	285	M-CSCO U-15	285	6,000
Shields Drlg Co Inc	*3	dsl	300	Wisn Gnt	400	6,000
Thunderbird Drlg Inc	2	dsl	285	Natl T-32	285	5,500
Saline County						
Donald T Ingling	4	dsl	225	Brwstr N-4	225	5,500
Earl F Wakefield	1	dsl	440	Wisn Mogul Rdair	440	5,000
Seward County						
Capitt Drlg Inc	6	dsl	410	Beth C-50	500	7,500
D & M Drlg Co Inc	1	gas-btne	550	Natl 50	550	8,000
	3	dsl	600	M-CSCO U-15	600	8,000
Moran Bros Inc	12	gas	350	Crdwll "S"	250	4,000
Stafford County						
Barnett Drlg Inc	6	dsl	265	Natl T-25	265	5,000
Garvey Drlg Co	8	dsl	175	Wisn Gnt	296	5,000
	14	dsl	175	Wisn Gnt	296	5,000
Shields Drlg Co Inc	*2	dsl	300	Beth C-50	300	8,000
Stanton County						
Herndon Drlg Co	4	gas	480	Emsco G-450	630	7,000
Stevens County						
Capitt Drlg Inc	3	dsl	325	Beth C-50	500	7,500
Sumner County						
Davon Drlg Co	1	gas-LPG	255	Brwstr N-4	320	5,000
Thomas County						
Empire Drlg Co (KANS)	1	dsl	300	Natl T-32	300	5,000
KENTUCKY						
Henderson County						
Marhill Oil & Gas Co Inc	1	dsl	—	"Oilwell"	—	5,000
	2	btne	—	Bucyrus 36-L	—	4,500
Temple Drlg Co Inc	*12	dsl	300	L C Moore Mast Crdwll "S"	440	4,500
Hopkins County						
Stouder Drlg Co	*3	dsl	160	Crdwll	160	2,000
Mc Lean County						
Eakle & Holder Drlg Co	3	dsl	300	Ideco H-30	300	5,500
LOUISIANA						
Acadia Parish						
Drlg & Expl Co of Del Inc	36	stm	1400	Natl 34-8	—	15,000
	38	stm	1400	Emsco ECA	—	15,000
A W Eggleston Inc	2	gas-btne	900	Ideco PR-800	900	12,000
Falcon Seaboard Drlg Co	3	stm	625	BIW Drdngt	625	17,000
	12	stm	600	Natl 23-10½	600	20,000
Mac Drlg Co	3	stm	600	Natl 23-9-FE	1000+	20,000
Penrod Drlg Co	11	dsl	1850	Brwstr N-95	1490	15,500
Sunnyland Contr Co Inc	8	gas-gaso	—	Crdwll D	312	8,000
	9	dsl	—	Crdwll D	450	9,000
	11	dsl	—	Ideco H-750	520	11,000
Carnes W Weaver Drlg Co	6	gas	6000	Brwstr N-7	200	9,750

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Acension Parish						
M M Lindsey Drlg Co	1	gas	600	Brwstr N-55	675	8,500
Allen Parish						
Sunnyland Contr Co Inc	7	dsl	—	Ideco H-40	450	8,000
Assumption Parish						
Gracey-Hellums Corp	Bge 2	stm	1200	Natl 23-9-FE	1200	15,000
Beauregard Parish						
Delta Drlg Co	31	gas-btne	1020	Emsco J-1000	1260	13,000
Beinville Parish						
Milton Crow Inc	*3	dsl	800	Brwstr N-7	600	9,500
Montgomery Drlg Co	1	gas-btne	700	Emsco GA-500	600	9,500
Wheless Drlg Co	13	gas-btne	820	Emsco J-750	850	10,500
Bossier Parish						
Korn Drlg Co Inc	*3	dsl	247	Emsco 250	260	6,000
C M Roberson Drlg Co	1	gas-btne	400	Brwstr N-45	400	7,300
Wheless Drlg Co	1	gas-btne	510	Brwstr N-45	450	7,500
Caddo Parish						
Kern Drlg Co Inc	*1	dsl	247	Emsco 250	260	6,000
L & N Drlg Co	*2	btne	280	Wlsn Super	120	2,500
Lunsford Drlg Co	1	LPG	185	Brwstr N-3	145	4,000
	2	LPG	145	Wlsn Spr	145	2,500
Woolf & Magee Inc	1	stm	1000	Natl 34-10-FE	1200	15,000
Calcasieu Parish						
Penrod Drlg Co	32	dsl	1850	GD 1500	1840	18,000
Ruhl Drlg Co Inc	*1	gas-btne	645	Brwstr N-7	675	9,500
Fred Wilson Drlg Co	8	gas	1600	Natl 110	1200	16,000
Cameron Parish						
Brewster-Bartle Drlg Co Inc	14	dsl	—	Natl 125	—	16,000
Circle Drlg Co Inc	3	gas-elec	1500	Ideco Big Gnt	2100	15,000
	8	gas-btne	1200	M-CSCO U-20	1500	13,000
Delta Drlg Co	14	stm	900	Ideco Big Gnt	1690	15,000
Dixie Drlg Co Inc	1	dsl	1500	Beth 1013	1500	16,000
	2	dsl	2000	Beth Tornado	1500	16,000
Penrod Drlg Co	Bge 40	dsl	2000	Brwstr N-12-A	1725	18,000
Rowan Drlg Co Inc	30	dsl	2250	Emsco A-1500	2250	20,000
Falcon Seaboard Drlg Co	1	stm	600	Ideco Big Gnt	600	20,000
C B Webster Drlg Co	1	dsl	1650	"Oilwell" 96	1800	17,000
	4	stm	1200	Natl FE-34-10	1200+	15,000
Wheless Drlg Co	Bge 12	gas-btne	1085	Natl 80	1300	12,000
Fred Wilson Drlg Co	10	gas	1050	Natl 55	800	10,500
Catahoula Parish						
Dorris Ballew Inc	6	dsl	380	M-CSCO U-15	600	7,500
McGoldrick & Watson Drlg Co	3	dsl	300	Spencer 500-DW	250	5,000
Claiborne Parish						
Arrow Drlg Co	16	gas	900	Natl 125	—	14,000
Drlg & Expl Co of Del Inc	32	stm	1400	Emsco ECA	—	15,000
The H & S Drlg Co	*2	gas-btne	1324	Brwstr N-95	1200	14,000
Maritzky & Bibby	1	gas	330	Brwstr	185	5,000
	2	gas	330	Crdwll	145	3,000
Wheless Drlg Co	10	gas-btne	1020	Natl 100	1200	13,000
Concordia Parish						
Fortenbery Drlg Co	4	dsl	300	Ideco H-30	250	7,000
Woolf & Magee Inc	11	gas-btne	275	Beth S-45	275	10,000/2⅛"
Evangeline Parish						
Delta Drlg Co	21	gas-btne	800	Beth Tornado DH-3-EB	650	9,500
Franklin Parish						
Montgomery Drlg Co	3	gas-btne	225	Crdwll S	200	5,000
Iberia Parish						
Brewster-Bartle Drlg Co Inc	4	gas	—	"Oilwell" 76	—	11,000
	15	gas	—	Emsco	—	10,000
Wheless Drlg Co	4	stm	1000+	Emsco UBLS-54	1000+	12,000
Iberville Parish						
Circle Drlg Co Inc	5	gas-btne	1500	Brwstr N-12	1440	15,000
Delta Drlg Co	35	gas-btne	1200	Emsco J-1100	1200	15,000
M M Lindsey Drlg Co	*2	gas	185	Natl T-32	290	6,500
Jackson Parish						
Arrow Drlg Co	31	gas	900	Emsco 750	—	10,000
Milton Crow Inc	4	gas	900	Brwstr N-75	750	11,000
	*5	dsl	900	Brwstr N-75	850	11,000
Jet Drlg Co Inc	2	dsl	600	Brwstr N-7	600	9,000
	3	dsl	1000	Brwstr N-75	700	11,000
Rowan Drlg Co Inc	Bge 26	gas-btne	1200	Natl 100	1200	14,000
Jefferson Parish						
Delta Drlg Co	45	stm	—	Emsco UH-54	1000	15,000
Rowan Drlg Co Inc	Bge 6	dsl-elec	1200	Emsco ED	2800	18,000
Sea Drlg Corp	*5	dsl	2500	M-CSCO	2500	18,000
C B Webster Drlg Co	3	gas	1250	Emsco J-1250	1300	15,000
Wheless Drlg Co	Bge 6	gas-btne	1000	Wlsn Titan	1200	12,000
	Bge 15	dsl	1975	Natl 130	1900	18,000
Jefferson Davis Parish						
Circle Drlg Co Inc	4	gas-btne	800	Brwstr N-75	960	11,000
Clegg & Hunt	3	dsl	—	Wlsn Titan 56	800	11,500
Steen Drlg Co	2	stm	600	Emsco ECA	—	15,000
Symons Drlg Co	2	gas	800	M-CSCO U-15	800	11,500
Fred Wilson Drlg Co	11	gas	1050	Natl 55	800	10,500
Lafayette Parish						
Clegg & Hunt	1	stm	—	Emsco 10	—	15,000
Falcon Seaboard Drlg Co	2	stm	600	Ideco Big Gnt	600	20,000
Lafourche Parish						
Brewster-Bartle Drlg Co Inc	10	dsl	—	"Oilwell" 76	—	11,000
Circle Drlg Co Inc	Bge 6	dsl-elec	2300	Ideco E-2500	2750	20,000
Clegg & Hunt	8	dsl	—	—	1275	18,000
Crawford Drlg Co	2	stm	1000	Emsco ECA	1000	15,000
Delta Drlg Co	47	dsl	1700	Ideco PR-1050	1560	14,000
Dixie Drlg Co Inc	3	dsl	3300	Beth B-3661	3000	16,000
Kelly Drlg Co Inc	3	pwr	1850	"Oilwell" 96	1500	18,000
Norton Drlg Co	Bge 4	dsl	1600	Emsco J-1250	1600	17,000
Penrod Drlg Co	15	dsl	2000	GD-2100	2200	25,000
	Bge 42	dsl	2000	Brwstr N-12-A	1150	18,000
Rimrock Tidelands Inc	14	dsl	2000	Emsco A-1500	2000	20,000
Rowan Drlg Co Inc	Bge 1	dsl-elec	1600	Emsco ECA	2475	18,000
	4	gas-btne	900	Natl 75	1149	11,000
Wheless Drlg Co	Bge 11	gas-btne	1085	Emsco J-1250	1400	13,500
La Salle Parish						
Justiss-Mears Oil Co Inc	5	gas	280	Mdl S Crdwll	225	3,700
	6	dsl	380	Emsco GA-250	300	6,000
Lincoln Parish						
Dixilyn Corp	5	gas	950	Natl 100	950	14,000
The H & S Drlg Co	*1	gas-gaso-btne	1324	Brwstr N-95	1200	14,000
Penrod Drlg Co	7	dsl	1700	GD-1100	1900	14,500
Pyburn Drlg Co	2	gas	590	Wlsn	700	9,000
Woolf & Magee Inc	7	gas-btne	800	Beth MC-450	800	11,000
Orleans Parish						
Dixie Drlg Co Inc	4	dsl	1500	Beth 1013	1500	16,000
Ouachita Parish						
Dixilyn Corp	7	dsl	2475	Natl 110	2475	15,000
Hydro Drlg Co Inc	1	gas	200	Bunn 1 Hy	300	2,800
	2	gas	200	Wlsn Mogul	200	5,000
Jet Drlg Co Inc	5	gas-btne	700	Brwstr N-75	800	10,500
Wheless Drlg Co	2	gas-btne	770	Brwstr N-7	800	9,500

AIR OPERATED

POWER SLIPS

Slip bowl assures positive alignment of the slips with drill pipe. Eliminates "Bottle-necking". KelCo's safety latch *works!*

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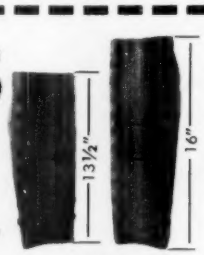
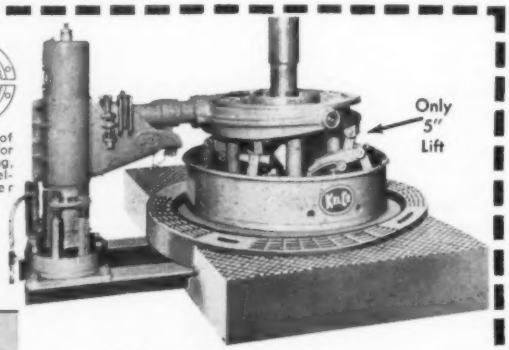


KelCo Standard and Long Dies Give More Pipe Contact

Top view of slip dies for J-6, J-7 long, or J-6-J Kel-Co Power Slips



Model J-6 Regular, J-7-Long, and J-6-J Slim-Hole Power Slips

Cathead
Power Slips
Tubing Tongs

KELCO — BE SAFETY WISE

BEN F. KELLEY CO., INC.
18 South Madison
TULSA, OKLAHOMA

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Plaquemines Parish						
Brewster-Bartle Drlg Co Inc	5	dsl	—	"Oilwell" 96	1500	16,000
Clegg & Hunt	Bge 11	dsl-elec	2600	Ideco 2500	1900	23,000
Producers Drlg Co Inc	*1	dsl	2400	M-CSCO U-1220	2400	20,000
	3	dsl-elec	2600	Ideal	1200	20,000
Rowan Drlg Co Inc	Bge 21	dsl-elec	1000	Emsco ECA	1920	16,000
	32	gas-btne	1545	Natl 100	1545	14,000
Southeastern Drlg Co	Bge 21	—	2200	"Oilwell" 96	2200	16,000
Wheless Drlg Co	Bge 9	dsl	1450	Natl 130	1470	18,000
Pointe Coupee Parish						
Fortenbery Drlg Co	1	dsl	300	Ideco H-40	300	10,500
Rapides Parish						
Woolf & Magee Inc	12	gas-btne	275	Beth S-45	275	10,000/2⅛"
St. Bernard Parish						
Producers Drlg Co Inc.	*2	dsl	2200	M-CSCO U-914-B	1800	18,000
St. Charles Parish						
Norton Drlg Co	Bge 5	dsl	1600	"Oilwell" 96	1600	17,000
Penrod Drlg Co	Bge 41	dsl	1500	Emsco J-1100	1100	14,000
Southeastern Drlg Co	Bge 14	—	1600	"Oilwell" 96	1600	16,000
Fred Wilson Drlg Co	7	gas	1400	Natl 80-B	800	12,500
St. James Parish						
C B Webster Drlg Co	8	stm	1600	Natl FE-23-10½	1200+	15,000
St. Landry Parish						
Pernie Bailey	1	gas	650	Brwstr N-75	—	11,000
A W Eggleston Inc	1	gas-btne	700	Ideco PR-800	700	11,000
St. Martin Parish						
Pernie Bailey	2	gas	800	M-CSCO U-40	—	11,000
Rowan Drlg Co Inc	Bge 20	dsl	1120	Natl 75	1300	11,000
Fred Wilson Drlg Co	9	gas	1400	Natl 80-B	800	12,500
St. Mary Parish						
Brewster-Bartle Drlg Co Inc	3	dsl	—	"Oilwell" 96	1500	16,000
Delta Drlg Co	55	dsl-elec barge tender	2000	Emsco ECB-54L	1200	15,000
A W Eggleston Inc	3	dsl	1500	Ideco PR-1050	1500	14,000
Falcon Seaboard Drlg Co	44	dsl	1250	Beth B-3661	1250	22,500
Gracey-Hellums Corp	Bge 4	dsl	1775	Emsco A-1500	1900	20,000
Geo H Jett Drlg Co	114	dsl	2000	Grdnr-Denver	2100	30,000
Penrod Drlg Co	14	dsl	2000	Brwstr N-12-A	2000	20,000
	17	gas-btne	1825	Brwstr N-12-A	1650	18,000
	18	dsl	2250	Natl 1625	2200	25/30,000
	Bge 46	dsl-elec	2500	Emsco ECB	1800	20,000
Rimrock Tidelands Inc	15	dsl	2000	Brwstr N-12-A	2000	20,000
Rowan Drlg Co Inc	Bge 3	dsl-elec	2150	Emsco EDA	3455	20,000
	Bge 13	dsl-elec	1700	Emsco FCA	2700	18,000
	Bge 14	dsl-elec	1600	Emsco ECA	2325	18,000
Salt Dome Prod Co	*14	dsl	—	Natl 55	850	10,000
C B Webster Drlg Co	Bge 9	dsl	1850	Emsco J-1400	2200	17,000
Wheless Drlg Co	5	dsl	2150	Emsco J-1400	1575	18 000
	Bge 14	dsl	1700	Emsco J-1400	1400	18,000
Sabine Parish						
Carter-Jones Drlg Co	11	gas-btne	—	—	280	6,500
McGoldrick & Watson Drlg Co	1	btne	195	Brwstr N-3	145	4,000
Scooter's Drlg Serv	3	dsl	600	Brwstr N-55	600	6,000
Thompson Expl Drlg Co	10	dsl	184	Failing 2500	184	1,000
Tensas Parish						
Geo H Jett Drlg Co	112	dsl	1200	Brwstr 55	800	9,000
	107	dsl	600	Brwstr N-45	450	7,000
Justiss-Mears Oil Co Inc	8	dsl	350	Emsco GA-500	600	9,500
Pyburn Drlg Co	1	dsl	500	Ideco	600	9,000
Terrebonne Parish						
An-Son Offshore Drlg Co	Bge 1	dsl	900	Natl 75	900	12,000
	Bge 3	dsl	1200	Natl 125	1200	15,000
Brewster-Bartle Drlg Co Inc	2	dsl		"Oilwell" 96	1500	16,000
	6	dsl		"Oilwell" 96	1500	
	7	dsl		"Oilwell" 96	1500	16,000
	8	dsl		"Oilwell" 96	1500	16,000
Crawford Drlg Co	*1	dsl	500	Brwstr N-7	500	9,000
Delta Drlg Co	17	gas-btne	1020	Emsco J-1100	1300	15,000
	25	gas-btne	1520	Emsco J-1250	1250	15,000
	32	stm	1200	Ideco Big Gnt	1690	15,000
Delta Marine Drlg Co	*3	dsl	1200	Beth AC-702	1500	15,000
	*4	dsl-elec	2500	Emsco EDA	1400	15,000
Dillard-Waltermire Inc	8	stm	1200	Natl 34-10FE	1500	16,000
Gracey-Hellums Corp	Bge 5	dsl	1775	Emsco A-1500	1900	20,000
Kelly Drlg Co Inc	1	stm	1200	Ideco Jr Gnt	1500	15,000
	2	pwr	1200	"Oilwell" 96	1500	18,000
Norton Drlg Co	Bge 3	stm	1200+	Natl 34-62	1500	17,000
	Bge 6	dsl	1400	Emsco J-1250	1200	17,000
Penrod Drlg Co	Bge 47	dsl-elec	2500	Emsco EDA	1800	20,000
Southeastern Drlg Co	Bge 9		2200	"Oilwell" 96	2200	16,000
Wheless Drlg Co	Bge 7	dsl	2000	Natl 130	1900	18,000
	Bge 8	dsl	1700	Natl 130	1900	18,000

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Vermilion Parish						
Brewster-Bartle Offshore Co	1	dsl		"Oilwell" 96	1500	16,000
Brewster-Bartle Drlg Co Inc	12	dsl		"Oilwell" 96	1500	16,000
Circle Drlg Co Inc	7	gas-btne	1500	Ideco 7-11	1200	15,000
Columbia Drlg Co	Bge *1	dsl	800	"Oilwell" 76	750	12,000
Delta Drlg Co	19	stm	1200	Natl 34-10-FE	1690	15,000
	20	gas-btne	1520	Emsco J-1250	1250	15,000
	37	dsl	900	Beth MC-950	1400	15,000
Dillard-Waltermire Inc	6	stm	1200	Natl 34-10FE	1500	16,000
A W Eggleston Inc	4	gas-btne	700	Natl 60-A	700	10,000
Falcon Seaboard Drlg Co	53	dsl-elec	1250	Beth MC103	1250	20,000
C B Webster Drlg Co	Bge 6	dsl	2000	Emsco J-1400	2400	17,000
Fred Wilson Drlg Co	12	gas	1400	Natl 110	1200	16,000
Washington Parish						
Penrod Drlg Co	33	dsl	1500	Brwstr N-12-A	1725	18,000
Rimrock Tidelands Inc	11	gas-btne	1325	M-CSCO U-20	1900	20,000
Webster Parish						
Milton Crow, Inc	*6	gas	700	Brwstr N-7	500	9,500
Wheless Drlg Co	3	gas-btne	575	Emsco GB-350	450	7,500
West Baton Rouge Parish						
Penrod Drlg Co	2	dsl	800	Brwstr N-45	500	6,500
Winn Parish						
Taylor Expl Co Inc	8	btne		Failing		2,000
Woolf & Magee Inc	5	gas-btne	800	Beth MC-450	800	11,000
MICHIGAN						
Allegan County						
Calvert Drlg Inc	8	dsl	260	Ideco H-30	190	4,500
Calhoun County	11	dsl	260	Natl T-32	190	5,000
Keating-Parker Drlg Co	8	btne-gas	700	Natl 50	700	8,500
	20	btne-gas	450	Natl T-32	750	8,500
D B Lesh Drlg Co	2	dsl		Natl T-25	250	6,000
	4	dsl		Natl T-20	250	5,500
Midwestern Drillers Inc	3	dsl	370	M-CSCO U-15	750	8,500
Charlevoix County						
Graves & Meching Inc	1			B Erie 36L		
Hillsdale County						
D B Lesh Drlg Co	1	dsl		Natl T-12	250	5,000
Gene Miller Inc	7	dsl	435	Brwstr N-4	302	5,500
Macomb County						
Calvert Drlg Inc	21	dsl	350	Ideco H-35	260	7,500/4"
Monroe County						
Hack Drlg Co	2	btne		Beth	161	4,500
Newaygo County						
Hack Drlg Co	3	btne		M-CSCO U-15	412	8,500
St. Clair County						
Graves & Meching Inc	1			B Erie 36L		
	1			B Erie 48L		
Strain Drlg Co	1	dsl	300	Crdwll	400	5,000
MISSISSIPPI						
Adams County						
Justiss-Mears Oil Co Inc	10	dsl	280	Emsco GC-250	300	6,000
Rimrock Tidelands Inc	21	dsl	500	Emsco GB-500	600	10 000
Woolf & Magee Inc	10	gas-btne	275	Beth Breeze	275	10,000/2⅛"
Amite County						
Arrow Drlg Co	18	gas	1260	Emsco 1250		14,000
Dixilyn Drlg Corp	1	gas	950	Natl 75	950	12,000/3½"
Justiss-Mears Oil Co Inc	1	dsl	700	Emsco GB-800	1120	13,000
	11	dsl	825	Emsco GB-800	1100	14,000
Woolf & Magee Inc	14	power	800	Brwstr N-45	450	12,000/3½"
Brookhaven						
Marshall R Young Drlg Co	6	stm	1688	Natl 34	1480	16,000
	7	stm	1688	Natl 34	1480	16,000
Clay						
Arrow Drlg Co	32	gas	900	Beth 450		10,000
Copiah County						
Rimrock Tidelands Inc	19	dsl	1410	Beth MC-950	1200	18,000
Covington County						
Big Chief Drlg Co	34	dsl-elec	2560	Emsco EDA-460	1600	18,000
Zach Brooks Drlg Co	8	gas	2600	Brwstr N-12	2600	18,000
Dawson County						
Zach Brooks Drlg Co	6	dsl	1300	Brwstr N-75	1300	12,500
Franklin County						
Cook Drlg Co	22	gas	375	Wlsn Spr Mogul	450	10,000
Hancock County						
Marshall R Young Drlg Co	12		740	Natl 50-A	558	10,000
Hinds County						
Big Chief Drlg Co	2	gas	1875	Natl 125	1815	16,000
Sunnyland Contr Co Inc	14	dsl	1800	Beth Tornado	1200	16,000
Jasper County						
Cook Drlg Co	23	gas	1300	Wlsn Spr Titan	1300	15,000
Drlg & Expl Co of Del Inc	23	gas-gaso	1000	Natl 100	900	12,000

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Jefferson County						
Cook Drlg Co	18	gas	750	Wisn Atlas	750	11,500
Woolf & Magee, Inc	2	power	700	"Oilwell" 52T	450	12,000/3½"
Jones County						
Zach Brooks Drlg Co	4	gas	1350	Brwstr N-75	1350	12,000
	9	gas-btne	1350	Brwstr N-95	1350	14,000
Geo H Jett Drlg Co Inc	105	dsl	600	Natl T-32	500	8,000
	108	dsl	1250	Brwstr N-75	1000	12,000
Rimrock Tidelands Inc	10	gas-btne	1400	Natl 110	1900	15,000
	12	gas-btne	1000	Natl 75	1215	12,000
	20	dsl	675	Brwstr N-55	900	10,000
Keoughan Drlg Co Inc	1	dsl	556	Crdwll 0		7,500
Marshall R Young Drlg Co	11		1350	Wisn Titan	1122	14,000
Penrod Drlg Co	6	dsl	2000	Natl 110	1350	16,500
Lamar County						
Dorris Ballew Inc	8	dsl	1380	Natl 125	1725	16,000
Lincoln County						
Marshall R Young	8		1350	Wisn Titan	1122	14,000
Marion County						
Arrow Drlg Co	22	gas	1250	Emsco 1250		14,000
Oktibbeha County						
Cook Drlg Co	20	gas	1125	Wisn Titan	1125	12,500
Perry County						
Dorris Ballew Inc	4	dsl	760	U 914C	1900	15,000
Pickens County						
Cook Drlg Co	16	gas	1125	Wisn Titan	1125	12,500
Pike County						
Dorris Ballew Inc	2	dsl	760	Wisn Titan	1300	12,500
	3	dsl	760	Wisn Titan	1900	15,000
FWA Drlg Co	5					12,000
Justiss-Mears Oil Co Inc	7	dsl	600	Emsco J-750	900	11,500
	9	gas	350	Emsco GA-500	600	10,500
Rimrock Tidelands Inc	8	dsl	1000	Brwstr N-75	900	11,000
Sunnyland Contr Co Inc	12	dsl	1120	Ideco H-525SC	1000	10,000
Woolf & Magee Inc	15	power	600	Emsco 500	700	12,000/3½"
Marshall R Young Drlg Co	1		900	Natl 75	648	11,500
	3		900	Natl 75	830	11,500
	5		1350	Wisn Titan	1122	14,000
Rankin County						
Arrow Drlg Co	1	gas	900	Beth 810		11,500
Simpson County						
Arrow Drlg Co	17	gas	1260	Emsco 1250		14,000
Geo. H. Jett Drlg Co	106	dsl	1600	Brwstr N-95	1400	13,000
	116	dsl	2000	Natl 110	1500	15,000
Smith County						
Arrow Drlg Co	24	gas	1250	Emsco 1250		14,000
Zach Brooks Drlg Co	7	dsl	1350	Emsco J-1100	1350	14,000
Drlg & Expl Co of Del Inc	39	gas-gaso	1200	Emsco J-1100	1050	15,000
Woolf & Magee Inc	8	gas-btne	1300	Beth Tornado	1300	15,000
Walthall County						
Cook Drlg Co	19	gas	1125	Wisn Titan	1125	12,500
Wayne County						
Fortenbery Drlg Co	7	dsl	1000	IdecoM10000	700	12,000
Yazoo County						
Drlg & Expl Co of Del Inc	41	gas-gaso	1500	Emsco J-1100	1050	15,000
Rowan Drlg Co Inc	8	gas-btne	1920	Natl 125	1920	18,000
MONTANA						
Carbon County						
Rowan Drlg Co Inc	24	gas-btne	504	Natl 50	1077	8,500
Custer County						
Delta Drlg Co	43	dsl	400	M-CSCO U-10	450	6,000
Dawson County						
Helmerich & Payne Inc	8	gas	600	Natl 55	800	9,000
Fallon County						
Helmerich & Payne Inc	15	dsl	975	"Oilwell" 76	1000	11,000
Signal Drlg & Expl Inc	1	gas	800	M-CSCO	900	10,000
Fergus County						
Great Northern Drlg Co	6	gas	450	Crdwll D-53	450	7,500
Hose-Austin Drlg Corp	2	dsl	300	Natl T-32	320	5,500
Glacier County						
Great Northern Drlg Co Inc	1	dsl	300	Crdwll	300	6,000
Kullberg & Otthouse Inc	1	dsl	550	M-CSCO U-15	550	7,500
Mountain States Drlg Co Inc	9	gas-dsl	1400	Natl 125		15,000
Musselshell County						
Fitzpatrick Drlg Co Inc	3	dsl-btne	300	Natl T-20	200	5,500
	7	dsl	350	Ideco HB30SC	350	5,000
Great Northern Drlg Co	5	dsl	600	Crdwll D	600	8,000
Hose-Austin Drlg Corp	4	gas	500	Emsco GB-350	588	7,500
Pondera County						
Great Northern Drlg Co Inc	2	dsl	300	Crdwll	300	6,000
Powder River						
Hose-Austin Drlg Corp	1	dsl	350	Emsco GB-250T	450	6,000
Tradewinds Drlg Co	2	dsl		Emsco GA-300	274	6,000
True Drlg Co	6	gas-LPG	1000	Beth Twister	750	8,500
Roosevelt County						
Calvert Drlg Inc	26	gas-btne	1380	Natl 80-B	1380	14,000
Rowan Drlg Co Inc	23	gas-btne	1140	Natl 75	1503	11,000
Rosebud County						
Fitzpatrick Drlg Co Inc	2	dsl	500	M-CSCO U-22	500	6,500
Sheridan County						
Great Northern Drlg Co Inc	3	dsl	600	M-CSCO U-15	600	9,000
Penrod Drlg Co	31	dsl	1025	Brwstr N-75	830	11,000
Rutledge Drlg Co	3	gas-btne	900	Beth 450	850	12,500
Signal Drlg & Expl Inc	7	dsl	250	Beth S-55	600	8,000
Stillwater County						
Great Northern Drlg Co	7	dsl	300	Crdwell S	300	6,000
Oien Oil Corp	3	dsl	500	Natl T-20	280	5,000
Teton County						
Crannell Drlg Co	*1	dsl	400	U-15	450	6,000
Toole County						
Oien Oil Corp	4	dsl	200	Beth S-50	200	3,000
Wibaux County						
Gabe McCall Drlg Co	3	gas	1200	Natl N-80	1200	12,000
NEBRASKA						
Banner County						
Exeter Drlg Co	4	dsl	400	Natl T-32	400	7,000
Garvey Drlg Co	18	dsl	300	Wisn Rdair	450	7,000/3½"
Cheyenne County						
Garvey Drlg Co	16	dsl	300	Wisn Rdair	450	7,000/3½"
Jet Drlg Co Inc	1	dsl	300	Emsco G-500	500	6,500
Love-Miller Drlg Co Inc	1	dsl	450	Wisn Gnt	520	7,000
Dundy County						
Donnell Drlg Co	12	gas-btne	350	Beth S-45	350	4,500
Sterling Drlg Co	*5	btne	586	Emsco B G-350	586	7,000
Fiou County						
Murfin Drlg Co	3	dsl	300	Natl T-20	300	5,000
Harlan County						
John O Farmer Inc	*3	gas	330	Guffy Spad	330	7,000
Hayes County						
Claude Wentworth Drlg Co Inc	*5	dsl	400	M-CSCO U-15	500	8,000
Kimball County						
Love-Miller Drlg Co Inc	2	dsl	450	Brwster N-7	520	8,500
Murfin Drlg Co	6	dsl	300	Natl T-32	300	6,000
	7	dsl	300	M-CSCO U-15	300	7,000
Morrill County						
Herndon Drlg Co	3	gas	600	Natl 50	750	8,000
Red Willow County						
Exeter Drlg Co	6	dsl	300	Beth S-45A	300	5,000
John O Farmer Inc	*1	gas	330	Guffy Spad	330	7,000
Man Drlg Co	*4	gas	450	Wisn Mogul	450	6,500
Murfin Drlg Co	4	dsl	350	Wisn	400	7,000
Sterling Drlg Co	*1	dsl	370	Emsco G-300	370	4,500
	*6	dsl	440	M-CSCO U-15	440	6,500
Claude Wentworth Drlg Co Inc	*2	gas-dsl	240 dsl	Crdwll "S"	175 gas	5,000
	*3	gas-dsl	240 dsl	Crdwll "S"	175 gas	5,000
Richardson County						
Kirby Oil Ind Inc		dsl	300	M-CSCO U-34	275	4,500
Nemaha Oil Co	1	dsl	370	Frnks SAL3000	370	4,500/3½"
Sarpy County						
Kirby Oil Ind Inc		dsl	400	Mayhew 3000	200	3,000
NEVADA						
Mercury County						
Kerr-McGee Oil Ind Inc	7	gas	885	Natl 75	818	11,500
NEW MEXICO						
Chaves County						
Moran Oil Prod & Drlg Corp	1	gas	—	M-CSCO U-15	800	8,500
Davey O'Brien Drlg Co Inc	4	gas-btne	280	Wisn Spr	145	3,000
Rowan Drlg Co Inc	22	gas-btne	600	Natl 50	766	8,500
S P Yates Drlg Co	6	gas	1032	M-CSCO U-20	1032	13,500
Eddy County						
Gardner Bros Drlg Co Inc	14	gas-btne	750	Natl 100	1050	12,500
Lee Drlg Co	2	gas-gaso	1050	"Oilwell" 76	—	13,000
	3	gas-gaso	700	Natl 75	—	10,000
	4	gas-gaso	700	Natl 50	700	8,000
	5	gas-gaso	700	Natl 50	700	8,000
	7	gas-gaso	700	Natl 50	—	8,000
Lowe Drlg Co	4	gas	750	Natl 75	750	10,000
Moran Oil Prod & Drlg Corp	4	gas	—	M-CSCO U-34	300	5,000
S P Yates Drlg Co	1	dsl	450	M-CSCO U-34	375	6,500
	3	dsl	350	Natl T-12	300	4,000/3½"
Lea County						
Arrow Drlg Co	27	—	450	Emsco 500	450	7,500
Brantly Drlg Co Inc	7	gas	975	Beth 450	1125	12,500
Brewster-Bartle Drlg Co Inc	16	gas	—	"Oilwell" 860	1400	16,000

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Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Cactus Drlg Corp	4	gas	1185	"Oilwell" 76	1185	12,000
	7	gas	1000	"Oilwell" 76	1000	12,000
Carper Drlg Co Inc	5	gas	350	Beth S-55	2-365	6,500
	6	gas	350	M-CSCO U-36A	3-365	8,500
	7	gas-btne	650	Natl B-55	560	6,900
Drlg & Expl Co of Del	42	gas	1200	"Oilwell" 96	1600	17,000
Dual Drlg Co	*6	gas	350	Emsco GA-250	400	5,500
Durham Drlg Co Inc	3	gas	1250	U-20	1250	14,000
	4	gas	1300	Ideco 7-11	1300	16,000
FWA Drlg Co	9	—	—	—	—	5,000
	12	—	—	—	—	7,000
Great Western Drlg Co	6	gas	1650	M-CSCO U-914	1650	18,000
	8	gas	795	Natl 80-B	1650	14,000
	9	gas	1053	M-CSCO U-20	1600	16,000
	21	gas-gaso	840	M-CSCO U-914A	1260	15,000
Helmerich & Payne Inc	32	gas-elec	1100	"Oilwell" 96	1100	14,000
	41	gas	1200	Natl 110	1500	15,000
Hondo Drlg Co	5	gas	675	Natl 55	675	11,000
Johnn Drlg Co	7	gas	325	Brwstr N-45	400	7,000
Lee Drlg Co	1	gas-gaso	1050	Natl 100	700	13,000
Lowe Drlg Co	5	gas	750	Natl 75	750	10,000
	6	gas	1000	Natl 100	1000	12,500
	9	gas	2000	Natl 125	2000	17,000
	10	gas	1800	Natl 125	1800	17,500
Moran Oil Prod & Drlg Corp	2	gas	—	Natl 75	750	10,000
Norwood Drlg Co	1	gas-gaso	350	Wisn Gnt Rdair	600	8,500
Davey O'Brien Drlg Co Inc	3	gas-btne	700	Emsco GB-500	700	9,000
Parker Drlg Co	64	gas	900	Natl 50-A	1000	9,000
Pecos Drlg Co	6	gas	600	M-CSCO U-15	600	6,000/8,500
	11	gas	200	Beth S-45	200	3,000/5,000
H T Porter Drlg Co	7	gas	300	Wisn Torqair	250	4,500
Rowan Drlg Co Inc	2	gas-btne	840	Natl 75	1120	11,000
	7	gas-btne	1260	Natl 100	1680	14,000
Schoenfeld-Hunter-Kitch Drlg Co	4	LPG-gas	—	Natl 75	800	11,000
Ray Smith Drlg Co Nancy Ann II		gas-LPG	225	Ideco H-25	160	4,500/3½"
Tri-Service Drlg Co	7	gas	—	"Oilwell" 860	1350	17,000
Warton Drlg Co	5	gas	375	Natl 50	500	5/6,000
Rio Ariba County						
Arapahoe Drlg Co	1	gas-btne	300	Natl T-32	320	6,000
	2	gas-btne	300	Natl T-32	320	6,000
Brannon & Murray Drlg Co	1	gas-LPG	650	Brwstr N-55	650	8,500
Gardner Bros Drlg Co Inc	21	—	250	Wisn Mogul	250	4,500
Great Western Drlg Co	3	gas	680	M-CSCO U-15	680	7,500
	31	gas-gaso	307	M-CSCO U-15	840	9,000
Moran Bros Inc	5	gas	1400	"Oilwell" 860	2025	17,000
	7	gas	1100	Wisn Gnt	1000	12,000
	10	gas	600	Emsco GA-350	550	8,000
Star Drlg Inc	*2	dsl	225	Failing 90	250	5,000
Roosevelt County						
Great Western Drlg Co	4	gas	450	M-CSCO U-40	1100	10,000
	34	dsl	495	M-CSCO U-40	1200	10,000
Dale Mount Drlg Co	112	gas	1200	Emsco 750	1200	12,000
	115	gas	1200	Emsco 750	1200	12,000
Parker Drlg Co	59	gas	—	Natl 75	1000	11,000
S P Yates Drlg Co	2	gas	750	M-CSCO U-15	750	9,000
San Juan County						
Brannon & Murray Drlg Co	2	gas-LPG	550	Emsco GA-350	550	6,500
	3	gas-LPG	350	Brwstr N-4	250	5,000
	4	dsl	300	Brwstr N-4	300	5,500
	5	dsl	300	Brwstr N-4	300	5,000
Empire States Drlg Corp	2	gas	450	Ideco H-35	450	5,500
	3	gas	200	Crdwll RL	250	3,500
Exeter Drlg Co	3	btne	850	Natl 50-A	850	8,500
Foree Drlg Co	2	gas-btne	300	M-CSCO U-15	600	7,500
Gardner Bros Drlg Co Inc	4	2 NKR	—	Natl 50	550	7,500
	17	gas-btne	550	Natl 50-A	700	8,500
	18	gas-btne	400	Natl 50	575	7,000
Great Western Drlg Co	14	dsl	320	M-CSCO U-15	800	9,000
	20	dsl	265	Frnks SAL-1600	600	5,500
	23	dsl	500	M-CSCO U-15	800	9,000
	25	gas-gaso	275	M-CSCO U-914A	1530	18,000
	32	gas	353	M-CSCO U-15	750	7,500
	42	dsl	500	Emsco G-500	800	9,000
Lohmann-Johnson Drlg Co Inc	11	gas	325	Natl 50	600	6,000
Moran Bros Inc	1	gas	1000	"Oilwell" 760	1200	14,000
	3	gas	550	Emsco GB-350-52	550	8,000
	9	gas	700	"Oilwell" 66	750	9,500
Rutledge Drlg Co	*4	gas-btne	475	Beth C-50	425	8,000
NORTH DAKOTA						
Battineau County						
Circle "A" Drlg Co Inc	5	dsl	300	Wisn Single Gnt	300	5,000
Bowman County						
Tradewinds Drlg Co	4	dsl	—	Emsco GB-800	1275	13,000
Burke County						
Calvert Drlg Inc	24	gas-btne	600	M-CSCO U-15	600	7,500
Hondo Drlg Co	3	gas	675	M-CSCO U-15	675	7,500
Lohmann-Johnson Drlg Co Inc	1	dsl	300	Natl 50	450	5,500
Man Drlg Co	*3	gas	650	Wisn Gnt	650	6,500
Pico Drlg Co	3	gas-btne	610	M-CSCO U-15	470	8,500
Rutledge Drlg Co	*6	gas-btne	362	Emsco 350	425	8,000
Star Drlg Inc	*1	btne	225	Hydrill	150	3,000
M-H-O Drlg Co	9	dsl	800	Crdwll D	450	7,500/4
Divide County						
Circle "A" Drlg Co Inc	14	gas	600	Brwstr N-7	700	9,000
Golden Valley County						
Tradewinds Drlg Co	3	dsl	—	Emsco GB-800	1275	13,000
McHenry County						
Calvert Drlg Inc	22	gas-btne	320	Ideco H-35	330	7,500/4"
McKenzie County						
Penrod Drlg Co	5	dsl	1250	Emsco A-1100	1575	15,000
Rowan Drlg Co Inc	15	gas-btne	1140	Natl 75	1503	11,000
Rutledge Drlg Co	*1	gas-btne	1100	Beth 810	1275	15,000
Sterling Drlg Co	3	dsl	1100	Emsco GB-800	1100	12,000
Mercer County						
Circle "A" Drlg Co Inc	15	dsl	700	"Oilwell" 76	700	12,000
Ward County						
Delta Drlg Co	53	gas-btne	310	Beth S-50	225	5,500
Williams County						
Calvert Drlg Inc	25	gas-btne	1050	Beth 810	1100	12,500
M-H-O Drlg Co	8	gas-btne	800	M-CSCO U-15	800	8,500
Penrod Drlg Co	19	dsl	825	Brwstr N-7	700	10,000
OHIO						
Knox County						
Delta Drlg Co	24	dsl	670	Emsco GC-500	500	8,500
Stark County						
Glenn Gillespie & Sons Inc	*8	LP-gas	—	Copr Skytop 66	200	—
	*7	dsl	—	Frnks 658 TRD	225	3,000
Morrow County						
Graytex Drlg Co	1	gas	325	Natl T-32	400	6,500
OKLAHOMA						
Alfalfa County						
Davon Drlg Co	2	gas-LPG	350	Brwstr N-4	320	6,500
Atoka County						
Walters Drlg Co Inc	14	gas	—	Mayhew 1000	150	400/2⅛"
Beaver County						
Barrett Drlg Co	2	gas	600	Natl 50	600	7,500
	5	gas	750	Natl 50	750	9,000
E B Clark Drlg Co	2	gas-btne	750	Wisn Gnt	600	8,500
Falcon Seaboard Drlg Co	35	gas	600	Brwstr N-7	600	8,500
Foree Drlg Co	4	gas-btne	325	Emsco GA-500	500	7,500
Garvey Drlg Co	20	dsl	300	Wisn Mogul 42	450	7,000
Lynn Drlg Co	1	gas-btne	300	Natl 50	600	8,000
Midwestern Drillers Inc	2	dsl	320	M-CSCO U-15	600	7,500
	8	dsl	370	M-CSCO U-15	750	8,500
Moran Bros Inc	2	gas	700	Emsco GA-500	750	9,500
	17	gas	800	U-15	750	9,000
Nichols Drlg Co	3	gas	—	—	—	8,500
R W Rine Drlg Co	2	dsl	520	Brwstr N-7	600	8,500
Service Drlg Co	15	gas	400	Wisn Gnt	400	6,000
	Stacked out and stripped of usable equipment					
	17	gas	950	Wisn Super Atlas	700	11,000
Unit Drlg Co	*2	gas	900	M-CSCO U-15	900	8,500
Wagner & Wyant Drlg Co Inc	3	dsl	300	M-CSCO U-15	480	7,500
Earl F Wakefield	6	dsl	960	Wisn Atlas Rdair	960	13,000
Beckham County						
E L Oliver Drlg Co	5	gas	600	Natl 50-A	600	6,000/8,000
Tommy Ward Drlg Co	*2	gas	—	Brwstr N-45	—	—
Blaine County						
Big X Drlg Co Inc	1	gas-btne	750	Beth MC-450	750	10,000
Helmerich & Payne Inc	24	gas	950	Natl 80	1100	11,000
	26	gas	500	Emsco GB-500	700	9,000
Perkins Drlg Co	2	gas-btne	—	M-CSCO U-15	675	8,500
Viersen & Cochran	11	gas	1575	Natl 110	1530	18,500
Bryan County						
Nichols Drlg Co	11	gas	—	—	8000	8,000
Caddo County						
C N P Drlg Co	1	gas	200	Wichtex	140	3,500
Graham Drlg Co (Okla)	1	gas-btne	235	Wisn Mogul	285	5,000
Harper-Turner Drlg Co	9	gas	220	Crdwll	194	4,000
Reed Drlg Co Inc	3	gas-gaso	180	M-CSCO U-34	180	3,200
Carter County						
Holliman Drlg Co	4	gas	325	M-CSCO U-15	500	7,500
Kingery Drlg Co Inc	10	btne gas	300	Wisn	375	4,500

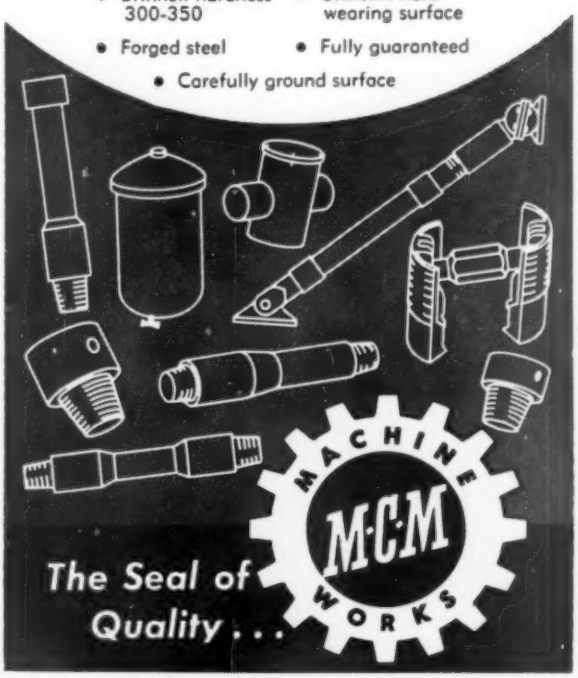
Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Nichols Drlg Co	4	Wisn	7000	—	—	7,000
	5	gas	—	—	—	14,000
Sherin Drlg Co	1	gas-gaso	500	M-CSCO U-15	600	8,000
	3	gas-gaso	500	M-CSCO U-15	600	8,000
	5	gas-gaso	750	Natl 55	750	9,000
Cherokee County						
Walters Drlg Co Inc	3	gas	130	Mayhew 1000	130	600/2⅛"
Cimarron County						
Herndon Drlg Co	6	gas	409	Natl T-32	559	6,000
Stickle Drlg Co	*4	dsl	300	Ideal T-32	300	6,000
Cleveland County						
Davon Drlg Co	5	gas-LPG	350	Brwstr N-45	425	8,000
Reed Drlg Co Inc	1	dsl	450	M-CSCO U-34	300	6,000
Coal County						
Rayna Drlg Co	5	gas-btne	—	Beth S-60	575	8,000
Comanche County						
Bryant-Hayward Drlg Co	6	gas	700	Brwstr N-7	700	9,000
Falcon Seaboard Drlg Co	33	gas	1350	Beth MC-1013	1350	20,000
Cotton County						
R Benton Ross Inc	1	dsl	225	Wisn	165	4,000
Creek County						
Mike Marrs	*5	gas	225	Wisn	200	4,000
Mesker Drlg Co	1	gas	214	Joy 300	170	2,500
	2	gas	185	Joy 300	160	2,500
Shaw-Hughes Drlg Co	2	btne-gas	270	Natl T-20	250	4,500
	3	btne-gas	270	Natl T-20	250	5,000
Unit Drlg Co	*1	gas	290	M-CSCO U-34	226	5,500
Custer County						
Big Chief Drlg Co	35	gas	2610	Natl 110	2610	16,000
Parker Drlg Co	56	gas	—	Natl 50	700	9,000
	61	gas-elec	—	Natl 130	2000	20,000
Dewey County						
Lynn Drlg Co	2	gas-btne	425	Natl 75	700	10,000
J S Montgomery	3	gas	1100	Natl 80	1100	12,000
Rayna Drlg Co	7	gas-btne	—	Beth MC-450	700	10,000
Ellis County						
Big Chief Drlg Co	24	gas	750	M-CSCO U-15	800	9,500
Falcon Seaboard Drlg Co	37	gas	600	M-CSCO U-15	600	8,500
O'Neal-Garvin Drlg Co	3	gas	650	Natl 50	650	9,500
Viersen & Cochran	9	gas	1500	Emsco J-1250	1590	18,000
Garfield County						
Catline Dodson Drlg Inc	2	gas	675	M-CSCO U-15	675	9,000
Dudley & Heath Drlg Co	6	dsl	265	Crdwll S	320	5,500
Hayward Drlg Co	1	gas	200	Carson	125	3,500
Indian Drlg Co	2	dsl	220	Ideco H-35-S	350	5,000
Keating-Parker Drlg Co	15	gas-btne	700	Natl 50	700	8,500
R W Rine Drlg Co	5	gas-btne	520	Brwstr N-55	550	8,500
Garvin County						
Don Clawson	1	gas-btne	340	Brwstr N-4	185	4,500
Garvey Drlg Co	21	dsl	500	M-CSCO U-15	640	8,500
O'Neal-Garvin Drlg Co	4	gas	650	Emsco GA-500	650	10,000
Parker Drlg Co	38	gas	—	Natl 100	1000	14,000
Perkins Drlg Co	3	gas-btne	400	Beth S-60	370	7,500
Rayna Drlg Co	9	gas-btne	—	Wisn Spr Titan	1050	13,000
Sherin Drlg Co	2	gas-gaso	800	M-CSCO U-15	800	9,000
Grady County						
Big Chief Drlg Co	30	gas	1545	Ideco 1050	1515	15,000
Falcon-Seaboard Drlg Co	51	gas	1600	Natl 125	1600	25,000
Helmerich & Payne Inc	44	gas	1200	"Oilwell" 96	1500	15,000
Holliman Drlg Co	1	gas	500	M-CSCO U-15	900	8,500
Parker Drlg Co	37	gas	—	Natl 100	1400	14,000
	41	gas	—	Natl 100	1400	14,000
Grant County						
Dirickson-Lewis Drlg Co	3	dsl	750	Ideco 700	750	8,500
Indian Drlg Co	1	btne	220	Ideco H-25	250	4,000
Reed Drlg Co Inc	2	dsl	375	Crdwll D	500	6,000
Viersen & Cochran	12	gas	325	Natl T-25	225	5,500
	14	gas	325	Natl T-25	225	5,500
Harper County						
Harper-Turner Drlg Co	1	gas	600	Natl 55	1000	12,000
Midwestern Drillers Inc	7	dsl	370	M-CSCO U-15	750	8,500
Viersen & Cochran	5	gas	925	Natl 50	800	9,000
Tommy Ward Drlg Co	*3	gas	—	Brwstr	—	—
Hughes County						
Jonco Drlg Co	*2	gas-gaso	400	Beth S-45-A	200	6,000
RWIT Drlg Co	2	gas	150	Mayhew 1000	190	1,000
Reed Drlg Co Inc	4	gas-gaso	300	M-CSCO U-34	290	5,000
	7	gas	500	Wisn Gnt Rdair	600	8,500
Troup & Suttles Inc	1	gas	750	Wisn Gnt	225	6,000
	2	gas-gaso	200	Wisn	370	5,000
Jefferson County						
Parker Drlg Co	30	gas	—	Natl 50	700	9,000
	32	gas	—	Natl 50	700	9,000

A Real Brake

FOR YOUR DRAW WORKS-

M-C-M BRAKE FLANGES!

- Forged seamless
- Heat treated
- Brinnell hardness 300-350
- Uniform hard wearing surface
- Forged steel
- Fully guaranteed
- Carefully ground surface



The Seal of Quality . . .

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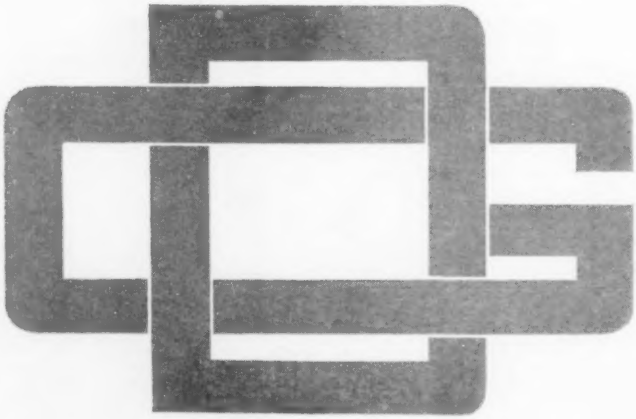
GARDNER-DENVER 700 DRAWWORKS

Only Gardner-Denver, with its 100 years' experience in building every type of equipment for the oil field and industry, could have produced the completely new GD-700 drawworks. An eight speed, seven hundred horsepower unit, it is unparalleled in its depth class. The GD-700 design features short shafts that reduce bearing center distances . . . unit engineering of sprockets and chains to reduce wear . . . heavily reinforced side plates for rigid bearing support. Every component has been selected and engineered to produce a balanced drawworks that will operate with speed and low cost maintenance on drilling programs in the 5,000 to 10,000 foot range. □ The drawworks, transmission, controls, compound, engines and pump drives are mounted on a single main skid. When moving, only the auxiliary brake with its skid and the engines need be removed. Throughout the engineering of the GD-700, every drilling problem has been considered to assure the operator of a drawworks that is fast, safe and easy to move. □

The new Gardner-Denver 700 drawworks features: 330° wrap drum brakes □ Eight hoisting speeds and reverse □ Four rotary speeds and reverse □ Air controls for all rig operations □ All friction clutches mounted outboard □ Auxiliary positive Lo drum clutch □ Positive transmission clutches □ Centralized brake lube-center □ Hydromatic brake water level control at console □ Two package moving **GARDNER-DENVER**



© 1961 Gardner-Denver Company, Quincy, Illinois

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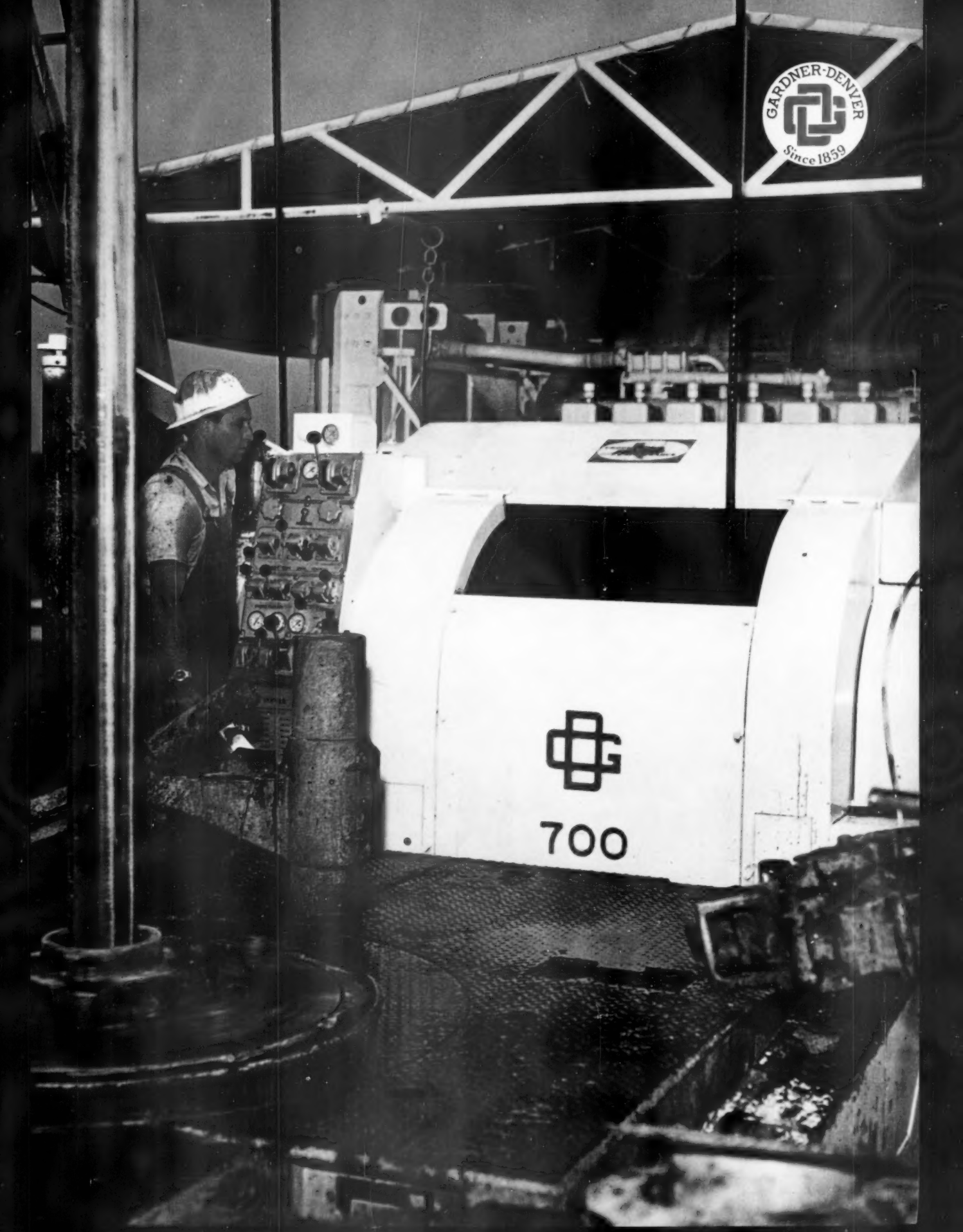
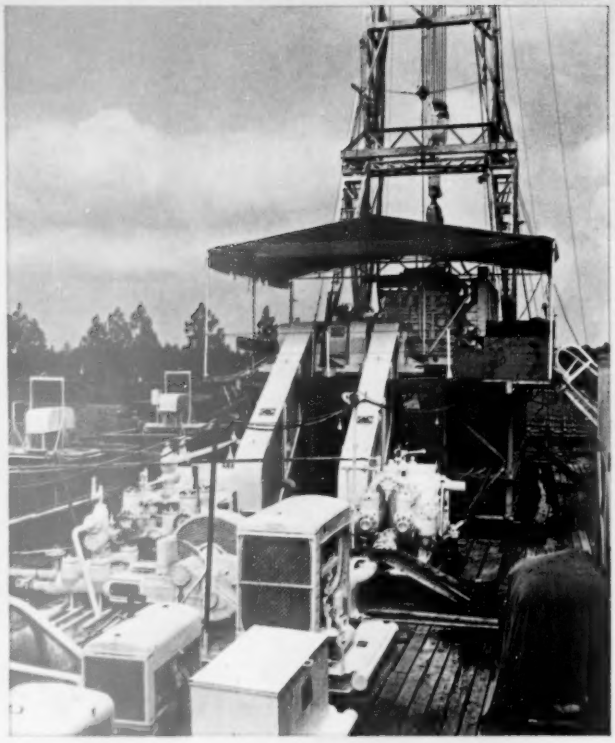
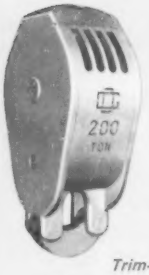

GARDNER-DENVER
Since 1859
700



The GD-700 is a single skidded drawworks with all components mounted in line on the main skid section except the hydromatic brake and the engines. On location only these two elements need be rigged up to be ready for spudding-in.

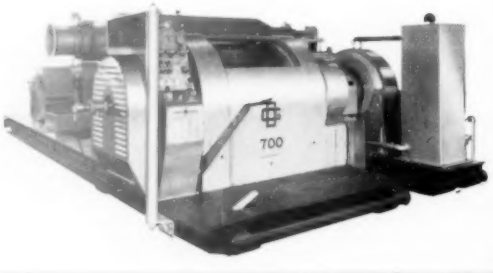
The drum clutches and chains are mounted outboard where they may be easily serviced and inspected. Drum and brakes can be checked or inspected by removing the full width front panel. A unique tilting arrangement allows the driller's console to drop forward exposing valves and piping.



Trim-True
TRAVELING BLOCK 200 TON

Turbo-Lubricated
SWIVEL 200 TON

Turbo-Lubricated
ROTARY 17 1/2"



700
GARDNER-DENVER DRAWWORKS

Full line manufacturing from rotary table to mud pumps . . . Gardner-Denver drilling equipment has been designed as a matched team for greatest drilling efficiency. In addition to the drawworks, there is a swivel, block, rotary table, compressor and mud pump to match every drilling program.

GARDNER-DENVER Since 1859 — 1 CENTURY

Gardner-Denver equipment combines imaginative engineering and modern technology with a century of experience.

GARDNER-DENVER

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Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Kay County						
Glenn Gillespie & Sons Inc	*1	gas	370	M-CSCO U-34	300	6,500
Dirickson-Lewis Drlg Co	1	gas	225	Natl T-16	185	4,500
Dave Morgan Drlg Co	—	gas-LPG	350	Natl T-32	320	6,000
Pete Morris Drlg Co	1	dsl-gas	550	Wlsn Gnt	550	6,000
Kingfisher County						
Arrow Drlg Co	20	gas	600	Emsco 350	—	7,000
	28	gas	600	Natl 50	—	8,000
Barrett Drlg Co	1	gas	600	Brwstr N-7	600	8,000
Big Chief Drlg Co	1	gas	450	JS&G Spad "Spr"	450	6,500
	27	gas	760	JS&G Spad "Spr"	760	9,000
Bryant-Hayward Drlg Co	2	gas	675	Natl 50	675	8,500
Calvert Drlg Inc	18	gas-btne	—	M-CSCO U-15	585	8,500
	19	dsl	350	M-CSCO U-15	600	8,500
	27	gas-btne	1380	Wlsn Spr	1380	12,500
Davon Drlg Co	3	gas-LPG	675	Brwstr N-7	675	8,500
T T Eason Co Div Eason Oil Co	14	gas	750	Emsco GB-500	940	10,000
	15	gas	750	Emsco T-250	450	6,000
Falcon Seaboard Drlg Co	21	gas	600	M-CSCO U-15	600	8,500
Garr-Woolley Co	2	dsl	700	Emsco 350	800	8,000
Glenn Gillespie & Sons Inc	*6	dsl	400	M-CSCO U-34	300	6,500
Great Western Drlg Co	5	gas-gaso	500	M-CSCO U-15	770	7,500
	10	gas	500	M-CSCO U-15	800	9,000
	24	gas	500	M-CSCO U-15	800	9,000
Hap Drlg Co	*1	gas	1600	Wlsn Spr Atlas	1200	12,000
Harper-Turner Drlg Co	2	gas	370	Natl 50	460	7,500
	4	gas	370	Natl 50	460	7,500
	8	gas	370	Natl 50	510	8,000
Helmerich & Payne Inc	36	gas	500	Emsco GB-500-S2	700	9,000
Keating-Parker Drlg Co	16	btne-gas	700	Natl 50	700	8,500
Nichols Drlg Co	8	gas	—	—	—	9,000
R W Rine Drlg Co	1	gas-btne	620	Brwstr N-55	600	8,500
	3	gas-btne	520	Brwstr 55	600	7,500
	6	dsl	520	Brwstr N-75	750	12,000
Slats Honeymoon Drlg Co	1	gas-btne	400	Natl 50-A	600	10,000
	2	dsl-elec	600	M-CSCO U-36-A	600	9,000
Stickle Drlg Co	*5	dsl	540	Brwstr N-55	540	9,000
	*6	dsl	300	Brwstr N-45	300	6,500
Viersen & Cochran	10	gas	675	Natl 50	450	8,500
Kiowa County						
Sherin Drlg Co	4	gas-gaso	1000	Natl 100	1050	12,000
Viersen & Cochran	4	gas	950	Natl 75	800	10,500
Latimer County						
Big Chief Drlg Co	5	gas	1545	Emsco 1250	1545	15,000
	36	gas	800	Natl 55	800	11,000
Falcon Seaboard Drlg Co	32	gas	1155	Beth MC-650	1155	14,000
	36	gas	1050	Natl 100	1050	12,000
	50	dsl	1065	Natl 75	1065	15,000
Viersen & Cochran	7	gas	1070	M-CSCO U-712-A	1200	15,000
Lincoln County						
Davon Drlg Co	4	gas-LPG	320	Brwstr N-2	320	4,000
Dudley & Heath Drlg Co	8	dsl	265	Brwstr N-45	325	6,500
Garr-Woolley Co	1	gas-btne	278	Emsco 300	378	6,500
Love County						
Falcon Seaboard Drlg Co	24	gas	1350	Beth MC-950	1350	16,000
Nichols Drlg Co	2	gas	—	—	—	14,000
	77	gas	—	Wlsn	—	18,000
McClain County						
Bryant-Hayward Drlg Co	1	gas	750	Emsco GB-800	750	10,500
T T Eason Co Div Eason Oil Co	12	gas	1000	Natl 80-B	1060	12,500
Falcon Seaboard Drlg Co	28	gas	1050	Beth MC-650	1050	14,000
Goff-Leeper Drlg Co	1	gas	800	Brwstr N-75	800	12,000
	4	gas	850	Wlsn Giant	850	12,500
	5	gas	850	Ideco H 7-11	850	13,000
Kerr-McGee Oil Industries Inc	16	gas	790	Natl 100	1248	12,500
Nichols Drlg Co	9	gas	—	—	—	10,000
Perkins Drlg Co	4	gas-btne	1200	Beth 650	1200	12,000
Rayna Drlg Co	10	gas-btne	—	Beth MC 450	700	10,000
Viersen & Cochran	2	gas	850	Natl 55	800	10,500
	8	gas	1350	Emsco J-1000	1200	14,000
Chester H Westfall Drlg Co	1	gas-gaso	625	M-CSCO U-15	700	10,400
	2	gas-gaso	625	M-CSCO U-15	800	10,400
	3	gas-gaso	625	M-CSCO U-15	800	10,400
Major County						
Big X Drlg Co Inc	2	gas-btne	750	Natl 55	750	10,000
Falcon Seaboard Drlg Co	38	gas	770	Wlsn Atlas	770	10,000
Helmerich & Payne Inc	46	gas	500	Emsco GB-500-S2	700	9,000
Sterling Drlg Co	*2	gas-btne	675	M-CSCO U-15	675	7,500
	*7	btne	586	M-CSCO U-15	586	7,500
Marshall County						
Falcon Seaboard Drlg Co	42	gas	1350	Beth MC-950	1350	16,000
Noble County						
Barrett Drlg Co	4	dsl	400	U-10 Unit	400	6,500
Bryant-Hayward Drlg Co	5	dsl	350	Frnks 5000	400	5,000
Kirk Drlg Co	*1	gas	200	T-12	200	2,500
	*1	dsl	225	N-3	225	4,000
	*1	dsl	265	T-20	265	6,000
	*1	dsl	265	U-34	265	5,500
Okfuskee County						
Dudley & Heath Drlg Co	7	dsl	265	Brwstr N-4	320	5,500
Johnson-Bates Drlg Co	1	gas	245	M-CSCO U-34	300	5,000
RWIT Drlg Co	*1	gas	185	Brwstr N-3	150	3,600
Seran & Howard Drlg Co	1	gas	225	Beth	200	5,000
Viersen & Cochran	13	gas	325	Natl T-16	175	5,200
Wade Drlg Co Inc	3	dsl	325	Crdwll L	225	4,500
Oklahoma County						
Catline Dodson Drlg Inc	1	gas	450	Beth S-45	220	5,200
Frizzell Drlg Co	1	gas-gaso	—	Wilson	600	7,500
Harper-Turner Drlg Co	5	gas	220	Emsco G-300	340	6,000
Parker Drlg Co	55	gas-elec	—	Emsco 750	2000	10,000
Osage County						
Falcon Seaboard Drlg Co	19	gas	194	M-CSCO U-34	240	5,000
Gross Drlg Co	1	dsl	500	M-CSCO U-34	250	5,000
	5	LPG	500	Beth S-45	250	5,000
Pawnee County						
Wade Drlg Co	*1	dsl	225	Crdwll L	185	3,500
Pittsburg County						
Bolin Oil Co & D H Bolin	5	LPG or NG	250	Wlsn Mogul	175	4,000
Dual Drlg Co	*2	gas	600	Wlsn Gnt	700	8,500
Viersen & Cochran	1	gas	675	Natl 50	450	8,000
	3	gas	950	Natl 75-CA	800	10,500
Ponotoc County						
Kingery Drlg Co Inc	3	dsl	210	Wilson	350	4,500
Pottawatomie County						
Barrett Drlg Co	3	dsl	400	Wlsn Gnt	400	5,500
Bodard Drilling Co	5	gas	450	M-CSCO U-34	185	6,000
Johnson-Bates Drlg Co	2	gas	325	M-CSCO U-34	245	6,500
Roger Mills County						
Gardner Bros Drlg Co Inc	11	gas-btne	750	Natl 100	1050	12,500
Parker Drlg Co	54	gas	—	Natl 125	1400	20,000
Seminole County						
Bodard Drlg Co	*1	gas	225	M-CSCO U-34	185	4,500
Dirickson-Lewis Drlg Co	2	gas	225	Natl T-20	185	5,500/3½"
M Houston Drlg Co	*2	gas	225	Unit U-34	185	5,500
Jonco Drlg Co	*1	gas-gaso	300	Emsco 160	200	5,000
Melco Drlg Co Inc	1	btne	265	Brwstr N-35	185	5,000
	2	btne	265	Brwstr N-35	185	5,000
Stephens County						
Bryant-Hayward Drlg Co	4	gas	900	Brwstr N-75	900	12,000
Helmerich & Payne Inc	47	gas-btne	2000	"Oilwell" 96-16	2000	20,000
Kirkpatrick Oil Co	1	gas	300	Beth S-60	336	7,500
Nichols Drlg Co	1	gas	—	Wlsn	—	7,000
	10	gas	—	—	—	8,000
Texas County						
Brantly Drlg Co Inc	1	gas	365	Emsco 500	500	9,000
Holm Drlg Co	6	dsl	780	Wlsn Gnt	520	8,000
Lohmann-Johnson Drlg Co Inc	3	btne	300	Natl 50	450	5,500
Moran Bros Inc	15	gas	400	Natl T-20	390	6,000
	16	gas	650	M-CSCO U-15	600	7,500
Service Drlg Co	6	dsl	295	N-4 Brwstr	230	5,000
Earl F Wakefield	4	gas-btne	750	Wlsn Gnt Rdair	750	9,500
Tommy Ward Drlg Co	*1	gas	—	M-CSCO U-15	—	—
Tulsa County						
Smiley Drlg Co	*4	gas	100	"Oilwell"	152	2,600
Washita County						
Holliman Drlg Co	2	gas	350	M-CSCO U-15	550	7,500
Parker Drlg Co	57	gas	—	Natl FE-23X10½	1800	18,000
	60	gas-elec	—	Natl 130	2000	25,000
	66	gas	—	Natl 130	2000	25,000
Woods County						
Goff-Leeper Drlg Co	2	gas	225	Brwstr N-4	350	6,000
Woodward County						
Arrow Drlg Co	11	gas	650	Emsco 500	—	8,000
Goff-Leeper Drlg Co	3	gas	450	M-CSCO U-15	450	8,000
Service Drlg Co	3	gas	700	M-CSCO U-15	700	8,500
PENNSYLVANIA						
Bedford County						
Fairman Drlg Co	1	gas-btne	500	Beth M-58	600	10,000
Cambridge County						
Lohmann-Johnson Oil Co Inc	2	gas	750	"Oilwell" 76	500	10,000
Cameron County						
Delta Drlg Co	33	gas-btne	624	Natl 50-A	450	7,000
Clearfield County						
Delta Drlg Co	34	gas-btne	800	M-CSCO U-15	600	8,000
Fairman Drlg Co	3	gas-btne	500	Wlsn Gnt	600	9,000

MAXIMUM PERFORMANCE...

...ENGINEERED INTO EVERY

Moore DRILLING STRUCTURE

LEE C. MOORE
CORPORATION
TULSA PITTSBURGH

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
S W Jack Drlg Co	2	dsl	800	M-CSCO U-15	800	8,500
	3	gas	650	M-CSCO U-15	650	8,500
Crawford County						
Graytex Drlg Co	2	gas	325	Natl T-12	325	4,500
Fayette County						
Delta Drlg Co	10	dsl	560	M-CSCO U-15	560	7,000
Potter County						
Fairman Drlg Co	2	gas-btne	500	"Oilwell" 66	600	9,000
Lohmann-Johnson Oil Co Inc	10	dsl	—	M-CSCO U-15	500	6,000
Somerset County						
Delta Drlg Co	30	dsl	670	Emsco G-500	500	8,500
Washington County						
Lohmann-Johnson Drlg Co Inc	6	btne	300	Crdwll S	440	4,500
	9	gas	750	"Oilwell" 66	500	10,000
York County						
S W Jack Drlg Co	1	gas	635	M-CSCO U-15	635	8,500
SOUTH DAKOTA						
Corson County						
Circle "A" Drlg Co Inc	12	gas	350	Brwstr N-45	350	8,000
TEXAS						
Anderson County						
Harry T Bryant Drlg Co Ltd	5	gas-btne	—	Beth M-58	1000	11,500
M J Delaney Co	24	gas-btne	500	Beth M-58	600	9,500
Holliman Drlg Co	6	gas	750	Wisn Atlas	950	11,000
Parker Drlg Co	34	gas	—	Natl 75	800	10,000
Trant Drlg Co	1	dsl	1200	U-15	1200	10,000
	2	dsl	1000	M 10,000 Ideco	1000	12,000
Andrews County						
B B M Drlg Co	1	gas-btne	950	Emsco GB-800	1050	14,000/4"
Davidson Drlg Co Inc	*A	gas-btne	1000	Emsco J-1250	1000	14,000
	*D	btne	315	Wisn Mogul	600	7,500
Great Western Drlg Co	17	gas-gaso	765	M-CSCO U-914-B	1260	15,000
Johnn Drlg Co	8	gas	500	Brwstr N-75	700	10,000
Llano Drlg Co	5	gas	1070	Natl 100	1050	14,000
Lowe Drlg Co	1	gas	500	M-CSCO U-15	500	7,500
	7	gas	1250	Natl 100	1250	12,500
	8	gas	1500	Natl 80	1500	15,000
Davey O'Brien Drlg Co Inc	2	gas-btne	840	Emsco GA-500	840	9,000
Parker Drlg Co	16	gas	—	Natl 100	1400	14,000
	53	gas	—	Natl 75	1000	11,000
Fred Pool Drlg Co	3	—	—	U-10	—	5,500
Schoenfeld-Hunter-Kitch Drlg	9	LPG-gas	—	Natl 75	900	11,000
Tri-Service Drlg Co	3	gas	—	"Oilwell" 66	900	9,500
Aransas County						
Camden Drlg Co	Bge 2	dsl	600	Natl T-32	300	7,500
Archer County						
Akin & Dimock	2	dsl	300	Beth S-55	420	7,000
Alan Drlg Co	*3	gas	300	Wisn Mogul	165	3,500
Jack Grace Drlg Co	17	gas-btne	370	Wisn Gnt	700	8,000
Atascosa County						
General Well Drlg Inc	3	gas-btne	425	Beth	183	5,500/3½"
J E Hillier	3	dsl	800	Crdwll KM-250	400	7,500/3½"
Sutton Drlg Co Inc	7	dsl	—	Ammco	225	5,000
Baca County						
Wes-Tex Drlg Co	2	btne	220	Brwstr N-4	400	5,500
Bee County						
Fitzpatrick Drlg Co	3	dsl	1150	Brwstr N-7	900	8,500
Penrod Drlg Co	4	dsl	2000	Natl 130	1840	20,000
Borden County						
Forest Blackstock Inc	3	gas	650	Emsco 500	650	10,000
Brantly Drlg Co Inc	4	gas	375	Beth S-55	480	6,500
FWA Drlg Co	11	—	—	—	—	9,000
Johnn Drlg Co	4	gas	375	M-CSCO U-15	600	8,500
Warton Drlg Co	3	gas	1620	Natl 110	1600	14,000
Bowie County						
M J Delaney Co	33	gas-btne	600	"Oilwell" 96	1400	15,000
Maxwell Herring Drlg Corp	5	—	—	—	—	14,000
Brazoria County						
J C Bickham Drlg Co Inc	2	gas	985	Brwstr N-75	750	12,000
Dillard-Waltermire Inc	4	stm	1200	Natl 34-10-FE	1500	16,000
Grey Wolf Drlg Co	3	dsl-elec	1625	Emsco ECB	1500	20,000
Holmes Drlg Co	1	gas-gaso	—	Beth ML-450	1000	11,000
Houston Oil Well Serv Co	4	gas-btne	—	Ideco M-10,000	855	10,000
Mac Drlg Co	10	gas-btne	1000	Natl 130	1300	20,000
	5	gas-gaso-btne	275	Beth S-45	450	7,500
Meadows & Walker Drlg Co	2	dsl	1950	Beth 1500	1578	16,000
Brooks County						
Bay City Drlg Co	3	gas	1430	"Oilwell" 66	580	11,000
Chiles Drlg Co	1	gas	600	Emsco 500	600	8,500
	4	gas	1000	Brwstr N-7	600	10,500
Fitzpatrick Drlg Co	2	gas	1150	M-CSCO U-40	900	11,000
Monte Cristo Drlg Corp	2	gas-btne	850	Emsco GA-500	700	8,500
Storm Drlg Co	7	gas	1200	U-15	700	9,500

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Brown County						
Low Drlg Co	3	btne	—	Wlsn	165	2,500
Calhoun County						
E L Bass Drlg Co	1	rotary	—	M-CSCO U-15	—	10,000/4½"
	2	rotary	—	M-CSCO U-15	—	10,500/4½"
Mangum Drlg Co	3	gas	1175	M-CSCO	675	9,000
Storm Drlg Co	5	dsl barge	1400	Natl 75	900	12,000
Sutton Drlg Co Inc	4	dsl	—	Brwstr N-4	875	10,500
Calhoun County						
Brewster-Bartle Drlg Co Inc	11	dsl	—	"Oilwell" 96	1500	16,000
	17	dsl	—	"Oilwell" 96	1500	16,000
Edgar Davis Expl Co	9	gaso-btne	225	Spencer	145	4,200
Low Drlg Co	2	btne	—	Wlsn	145	3,000
Davey O'Brien Drlg Co Inc	5	gas-btne	560	Wlsn Gnt	560	8,000
Carson County						
Drlg & Expl Co of Del Inc	24	gas	225	Wgnr Mrhse	400	5,000
	25	gas	225	Frnks 137/33 DTDX	400	5,000
FWA Drlg Co	13	—	—	—	—	4,500
Service Drlg Co	9	dsl	290	Natl T-12	300	4,000
Cass County						
Big Chief Drlg Co	38	gas	900	Natl 75	900	13,000
B G Byars Power Drlg Co	4	gas-btne	1110	Emsco J-750	1110	14,000
M J Delaney Co	27	gas-btne	500	Beth 450	850	11,000
	32	gas-btne	500	Beth 450	750	11,000
Jet Drlg Co Inc	6	gas-btne	1400	Brwstr N-95	1200	15,000
Parker Drlg Co	67	gas	—	Natl 75	700	10,000
Chambers County						
Brewster-Bartle Drlg Co Inc	9	dsl	—	"Oilwell" 96	1500	16,000
Grey Wolf Drlg Co	1	gas-btne	1170	Emsco GB-880	1050	12,500
Meadows & Walker Drlg Co	3	gas-btne	1005	M-58	1005	12,000
Storm Drlg Co	10	dsl barge	1200	Natl 50	700	9,500
Cherokee County						
Ace Drlg Co	4	gas-btne	500	Emsco G-500	630	9,000
Childress County						
Lin-Mour Drlg Co	1	gas	315	Wlsn Mogul	400	4,600
Coke County						
Capitan Drlg Co Inc	3	gas	500	Natl 50	500	7,500
Tucker Drlg Co	5	gas	545	Crdwll "O"	675	10,500
Wes-Tex Drlg Co	1	btne	250	Natl 50	650	7,500
Coleman County						
Norman Drlg Corp	2	dsl	330	M-CSCO U-10	350	5,000
Raiborn Drlg Co	2	gas	200	Crdwll RL	185	5,000
Colorado County						
Bay City Drlg Co	2	gas	476	U-34	190	5,500
	5	gas	1350	Brwstr N-75	900	12,000
J C Bickham Drlg Co Inc	10	dsl	2150	Natl 125	1350	16,000
Concho County						
Hondo Drlg Co	2	gas	450	M-CSCO U-15	450	5,500
Cooke County						
Berry Drlg Co	1	dsl	350	Wlsn Gnt	500	6,500
Falcon Seaboard Drlg Co	40	gas	1540	Beth MC-950	1540	20,000
Roy Guffey Drlg Co	5	gas-btne	440	M-CSCO U-34	235	5,500
MartinDee Drlg Co	1	btne	150	Wlsn	105	1,500
	2	btne	230	Wlsn Gnt	215	5,500
	3	btne	350	Wlsn Gnt	450	6,500
Taylor Expl Co Inc	1	btne	—	Failing	—	1 200
	7	btne	—	Mayhew	—	1,200
Trachta Drlg Co	1	dsl	250	Wlsn	185	3,000
Crane County						
Dillard-Waltermire Inc	12	gas	600	Wlsn Gnt	800	8,000
Dual Drlg Co	*5	gas	700	Emsco 500	700	8,500
Gardner Bros Drlg Co Inc	5	gas-btne	500	Natl 75	675	9,000
	12	gas-btne	750	Natl 100	1050	12,500
	16	gas-btne	1000	Natl 125	1400	15,000
	19	gas-btne	185	Crdwll R	200	3,300
	20	gas-btne	275	Natl T-25	350	4,000
Great Western Drlg Co	7	gas	265	Natl T-20S	272	4,500
	37	gas-gaso	700	M-CSCO U-40	1200	10,000
Guadalupe Drlg Co	1	gas-btne	700	Ideco M-1000	—	10,000
Helmerich & Payne Inc	9	gas	1200	"Oilwell" 96	1100	14,000
King-Phillips Inc	4	gas	700	Beth S-45E	350	6,500
Dale Mount Drlg Co	101	gas	850	EMSCO 500	570	9,000
	111	gas	1200	EMSCO 1250	1200	14,000
Ray Smith Drlg Co	Babe 4	gas-LPG	350	Brwstr N-4	160	5,500/3½"
Crockett County						
Brantly Drlg Co Inc	3	gas	700	Brwstr N-25	750	11,000
Forest Blackstock Inc	1	gas	700	EMSCO GB-350	700	9,000
Delta Drlg Co	2	gas-btne	400	Natl 50	450	7,000
Norwood Drlg Co	2	gas-gaso	800	Wlsn Super Atlas	1000	12,500
	8	gas-gaso	300	Wlsn	175	4,000
Ray Smith Drlg Co	Dorothy Jane 3	gas-LPG	350	EMSCO 250A	625	4,400/3½"
Crosby County						
John Grappe Drlg Co	*3	gas	1700	Beth M-58	850	12,000

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Dawson County						
Brantly Drlg Co Inc	8	gas	675	Beth 450	870	11,500
Cactus Drlg Corp	12	gas	665	"Oilwell" 76	665	9,000
Gardner Bros Drlg Co Inc	10	gas-btne	750	Natl 100	1050	12,500
Great Western Drlg Co	40	gas	450	Wlsn Atlas	840	10,000
Robinson Bros Drlg Co	2	gas	800	Brwstr N-75	800	10,000
Tri-Service Drlg Co	4	gas	—	U-15	700	8,500
	6	gas	1350	"Oilwell" 96	1350	16,000
De Witt County						
Chiles Drlg Co	5	gas	1700	Brwstr N-95	1500	14,000
Grey Wolf Drlg Co	2	dsl-elec	1250	ECA EMSCO	1250	20,000
J & C Drlg Co	5	dsl	1225	Wlsn Titan	1143	12,500
Mangum Drlg Co	2	stm	1400	Emsco	1400	12,000
Dickens County						
Thompson Expl Drlg Co	4	gas	184	Joy 275	184	2,800
Dimmit County						
General Well Drlg Inc	8	btne	400	Brwstr N-4	185	4,500/3½"
Duval County						
General Well Drlg Inc	1	pwr	450	Wlsn Rdair	200	6,000/3½"
	7	dsl	650	Crdwll	300	7,500
Ector County						
B B M Drlg Co	5	gas-btne	1400	Natl 110	1050	12,800
Bickerstaff & Tibbets Drlg Co	*5	gas	—	Frnks	320	5,000
Cactus Drlg Corp	6	gas	1200	Ideco 7-11	1200	12,000
	8	gas	585	Brwstr N-7	585	9,500
Dillard-Waltermire Inc	13	gas	800	Wlsn Titan	1200	12,000
Donnell Drlg Co	5	gas-btne	700	M-CSCO U-15	700	6,500
	6	gas-btne	1050	Beth MC-450	1050	10,000
	9	gas-btne	1400	Beth MC-950	1400	14,000
	14	gas-btne	360	Ideco H-40	360	4,500
Durham Drlg Co Inc	2	gas	648	U-15	648	8,500
FWA Drlg Co	2	—	—	—	—	9,000
	7	—	—	—	—	12,000
Helmerich & Payne Inc	42	gas	970	Natl 100	1000	13,000
Keating-Parker Drlg Co	19	gas-btne	350	Unit U-35	550	9,000
King-Phillips Inc	1	gas-gaso	695	Natl 50	—	7,500
Lee Drlg Co	6	gas-gaso	440	Beth S-55	—	6,000
Llano Drlg Co	9	dsl	300	Brwstr N-4	300	5,500
	10	gas	800	Brwstr N-55	600	9,000
Robinson Bros Drlg Co	3	gas	300	Brwstr N-55	500	6,500
	4	gas	300	Brwstr N-45	450	6,500
Schoenfeld-Hunter-Kitch Drlg Co	1	gas-LPG	—	Beth 650	1000	14,000
	6	gas-LPG	—	Beth 650	1000	14,000
	7	gas-LPG	—	Natl 110	1200	16,000
	10	gas-LPG	300	Beth Twister	300	6,500
Ray Smith Drlg Co	Sophie Jean	gas-LPG	625	Natl 50	625	8,000
Tri-Service Drlg Co	2	gas	675	"Oilwell"66	675	8,500
Edwards County						
Dual Drlg Co	*4	gas	900	Beth M-810	1050	13,000
Fayette County						
Hamman Oil & Ref Co	7	dsl	340	Brwstr N-75	600	11,000
Fisher County						
Dual Drlg Co	*3	gas	600	Beth M-58	700	9,500
Roy Guffey Drlg Co	4	gas-btne	500	M-CSCO U-15	500	7,500
Thomas & Saxon Drlg Co	2	gas-btne	—	Emsco 300	600	7,000
Wes-Tex Drlg Co	9	btne	460	Emsco GA-500	570	8,000
Foard County						
E W Moran Drlg Co	7	gas	410	Wlsn Gnt	410	7,500
W B Omohundro	8	btne	700	Wlsn Rdair	—	8,000
Ft Bend County						
J C Bickham Drlg Co Inc	1	stm	1800	EMSCO ECB	1400	15,000
Edman Drlg Co	*4	dsl	500	M-CSCO U-34	300	5,000
Carnes W Weaver Drlg Co	5	gas	465	U-34	185	5,800
Franklin County						
W B Hinton	4	gas-btne	—	Spencer M-7000	400	7,500
Gaines County						
B B M Drlg Co	6	gas-btne	1050	Emsco GB-500	650	10,000/3½"
	10	gas-btne	1100	Emsco J-750	800	7,000/3½"
Cactus Drlg Corp	1	gas	1800	Natl 110	1800	16,000
Davidson Drlg Co Inc	*C	btne	660	Emsco GC-500	660	9,000
Great Western Drlg Co	16	gas-gaso	775	M-CSCO U-914A	1260	15,000
O E Hall Drlg Co	1	gas	550	M-CSCO U-15	700	8,000
Llano Drlg Co	14	gas	300	Brwstr N-45	400	7,000
Gene McCutchin Drlg Co	8	gas	550	Natl 50	550	8,000
Dale Mount Drlg Co	114	gas	300	Crdwll	300	5,000
Parker Drlg Co	51	gas	—	Natl 50	700	9,000
Fred Pool Drlg Co	1	gas	580	M-CSCO U-15	600	7,500
Warton Drlg Co	4	gas	950	Emsco J-750	1000	12,000
Galveston County						
Steen Drlg Co	4	gas-btne	1350	Ideco 1050	1350	16,000
Texdrill Corp	*1	gas-LPG	574	Brwstr N-4	300	6,500
	*2	gas-dsl-LPG	988	M-CSCO U-15	560	10,000

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Garza County						
Forest Blackstock Inc	4	gas	700	Emsco GB-350	700	9,000
Dual Drlg Co	*1	gas	600	Wisn Gnt	700	8,500
Great Western Drlg Co	35	dsl	300	M-CSCO U-15	760	7,500
Glasscock County						
B B M Drlg Co	2	gas-btne	1100	Emsco GB-800	1050	14,000/4"
Goliad County						
Harkins & Co	1	gas-gaso	555	M-CSCO U-15	555	9,500
	4	gas-gaso	700	Wisn Gnt	700	9,500
Gonzales County						
Harkins & Co	8	gas-btne	1625	N-100	1810	14,500
Grayson County						
Falcon Seaboard Drlg Co	41	dsl	1350	Beth MC-950	1350	16,000
FWA Drlg Co	16	—	—	—	—	4,500
Jack Grace Drlg Co	12	gas-btne	625	Wisn Titan	1300	16,000
Hoffman Drlg Co	3	gas	255	M-CSCO U-15	600	7,500
E W Moran Drlg Co	4	gas	750	Wisn Gnt	650	9,500
Gregg County						
Tex-Mex Drlg Co	12	gas	—	M-CSCO U-15	—	9,000
Hansford County						
Garvey Drlg Co	6	dsl	276	M-CSCO U-15	640	8,500
Rayna Drlg Co	6	gas-btne	—	M-CSCO U-15	700	8,500
Hardeman County						
FWA Drlg Co	1	—	—	—	—	7,500
E W Moran Drlg Co	2	gas	500	Wisn Gnt	650	9,500
	3	dsl	500	Wisn Gnt	650	9,500
	5	gas	370	Natl 50	650	8,500
Harris County						
Mac Drlg Co	11	stm	800+	Natl 23-9F-ED	1000+	20,000
Taylor Expl Co Inc	6	btne	—	Failing	—	1,200
Carnes W Weaver Drlg Co	4	gas	250	Frnks	185	3,000
Harrison County						
Gulley Long & Hedge Drlg Co Inc	1	dsl	—	Beth Twister	—	9,000
Tex-Mex Drlg Co	9	gas	400	Emsco 250	450	5,500
Haskell County						
Roy Guffey Drlg Co	2	gas-btne	500	M-CSCO U-15	500	7,500
W B Omohundro	4	btne	450	Wisn Mogul Tcai	—	6,500
Sojourner Drlg Corp	2	dsl	320	M-CSCO U-15	265	5,000

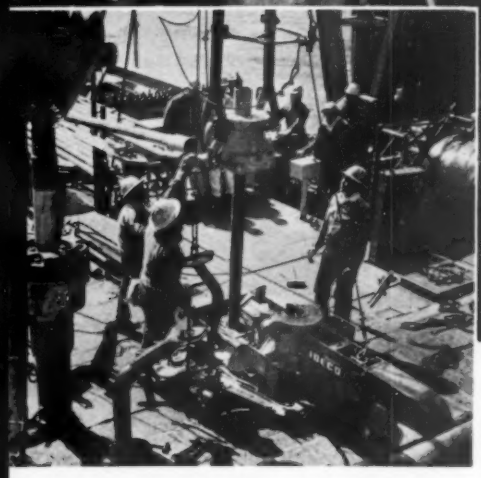
'BESTOLIFE

YOUR DRILL STRING LITERALLY HANGS BY A THREAD!
Protect your new string from seizing, galling and tearing with 'Bestolife's tool joint compound for your guarantee of long maintenance free life.

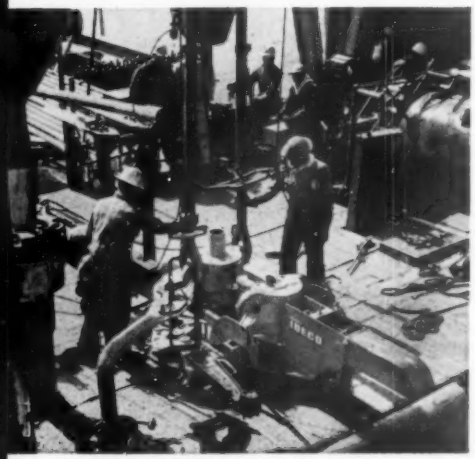
I. H. GRANCELL CO.
LOS ANGELES, CALIFORNIA • DALLAS, TEXAS

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Hemphill County						
Arrow Drlg Co	29	gas	650	Emsco 500	—	8,000
Dillard-Waltermire Inc	9	gas	800	Natl 100	1200	13,500
Lynn Drlg Co	3	gas-btne	1200	Natl 100	1500	17,000
Nichols Drlg Co	6	gas	—	—	—	15,000
Henderson County						
B G Byars Power Drlg Co	1	gas-btne	1170	Beth MC-450	775	11,000
M J Delaney Co	30	gas-btne	500	Beth 1013	1200	15,000
	31	gas-btne	450	Wisn Gnt Rdr	650	9,000
Delta Drlg Co	5	gas-btne	900	Natl 100	800	12,000
	40	gas-btne	325	Wisn Rdr Gnt	690	8,000
Delta Drlg Co	54	dsl	1250	Brwstr N-95	1000	13,000
Penrod Drlg Co	20	dsl	1400	Natl 80-B	1200	13,500
	21	dsl	1700	Brwstr N-85	1200	13,500
Hidalgo County						
Fitzpatrick Drlg Co	4	gas	1050	Beth Tornado	1000	13,000
Harkins & Co	7	dsl	600	M-CSCO U-15	600	9,500
Holmes Drlg Co	3	gas-gaso	—	Natl 110	1500	16,000
Monte Cristo Drlg Corp	3	gas-btne	950	Natl 55	900	10,000
	1	gas-btne	950	Natl 50-A	700	8,500
Viking Drlg Co	4	gas-gaso	980	Ideco M-10,000	750	12,000
Hockley						
Cactus Drlg Corp	5	gas	790	Natl 75	790	10,000
	10	gas	790	Beth M-58	790	10,000
Great Western Drlg Co	12	gas-gaso	1350	M-CSCO U-20	1755	18,000
Liano Drlg Co	4	gas	820	Natl 75	1050	12 000
Sitton & Norton Drlg Co	*1	gas-btne	380	Wisn Gnt	380	5 600
Hopkins County						
Robert M Bass Drlg Contr	1	gas-LPG	500	Wisn Rdair	800	10,000
	5	gas-LPG	300	Wisn Gnt	300	5,500
Delta Drlg Co	44	gas-btne	1300	Brwstr N-95	1300	14,000
Maxwell Herring Drlg Corp	1	—	—	—	—	6,000
Houston County						
Meadows & Walker Drlg Co	1	gas-btne	875	"Oilwell" 66	828	10,500
Howard County						
Black Drlg Co	1	dsl	275	Frnks	250	4,000/3½"
Highland Drlg Co	1	gas	600	Emsco GA-500	600	9 000
Hunt County						
Robert M Bass Drlg Contr	3	gas-LPG	400	Wisn Gnt Rdair	600	8,500
Hutchinson County						
FWA Drlg Co	14	—	—	—	—	4,500
Kerr-McGee Oil Industries Inc	*34	dsl	300	Frnks LTX 5000	300	5,000
Midwestern Drls Inc	11	gas	300	GB-350 Emsco	500	7,000
Service Drlg Co	*1	dsl	180	M-CSCO U-34	180	4,500
	*2	gas	296	M-CSCO U-34	200	6,000
Jack County						
Bolin Oil Co & D H Bolin	3	LPG or NG	350	Wisn Gnt	250	5,000
Jack Grace Drlg Co	9	gas-btne	255	Wisn Gnt	700	8,000
John W Harris Drlg Co	1	gas	500	Hou Prtble	450	6,500
Jackson County						
Big "6" Drlg Co	2	gas-btne	700	M-CSCO U-15	700	11,000
Edman Drlg Co	5	gas	600	Natl 50-A	600	10,000
H H Howell	1	dsl	375	Frnks 5000	250	7,000
Jefferson County						
J C Bickham Drlg Co Inc	4	gas	1120	Crdwll "O"	750	11,500
	*8	gas	800	Hou Port CT-5	600	9,500
Big "6" Drlg Co	5	gas-btne	820	Wisn Gnt	550	10,500
Clegg & Hunt	9	gas-btne	—	Natl 50-A	—	9,800
	10	gas-btne	—	Natl 50-A	—	10,000
Columbia Drlg Co	2	btne-NG	1375	Natl 75	675	11,500
Falcon Seaboard Co	52	dsl-elec	1250	Beth MC-1013	1250	20,000
Jim Hogg County						
Allen W Morris Drlg Co	4	gas-btne	590	MSCO 50	450	9,000
Parker Drlg Co	52	gas	—	"Oilwell" 76	1400	12,500
Jim Wells County						
Harkins & Co	2	dsl	300	Wisn Gnt	300	6,500
Miller Bros & Bowling	1	gas-btne	495	Emsco G-300	—	5,500
Karnes County						
Buzzini Drlg Co	8	gas-prop	1670	Wisn Titan	1220	14,000
	9	gas-prop	1889	Wisn Titan	1880	15,000
	10	gas-prop	1889	Wisn Super Titan	1880	16,000
Davis & Bates Inc	2	dsl	756	M-CSCO U-34	504	7,500
Holmes Drlg Co	6	gas-gaso	—	Beth MC-450	700	10,000
	7	gas-gaso	—	Beth MC-450	1000	11,000
Parker Drlg Co	58	gas	—	Natl 100	1400	14,000
Viking Drlg Co	2	dsl	475	Natl 50-A	500	8,500
	3	gas-gaso	800	M-CSCO U-15	660	9,000
Kenedy County						
Monte Cristo Drlg Corp	5	dsl	1200	Natl 80-B	1000	12,500
Kent County						
J W Mc Cutchen Drlg Co	3	gas	600	Wisn Spr Gnt	650	10,000
Tri-Service Drlg Co	5	gas	825	"Oilwell" 76	825	10,000

MOHOLE REPORT:



Above: A stand is being lowered into the hole. Below: Links are shifted automatically as two elevators rest on base.



12,000 ft. Drill String Handled By IDECO's Dual Elevator System

"An incredible feat."

This was the oil industry's concensus on the successful completion of Phase I of Project Mohole. CUSS I had drilled 600 feet into the ocean's floor under 12,000 feet of water off lower California.

To the scientists and oilmen aboard CUSS I a major question was this:

"Would the 12,000 feet of drill pipe and the handling equipment supporting it withstand the bending and twisting moments to which the pipe and equipment would be subjected while drilling in open waters?"

The answer is history:

Ideco's Duo-Matic Dual Elevator System was specified for handling the high-alloy, vanadium type drill string at depths over 9,000 feet because the chances of losing the pipe were great.

The possibility of bending, scoring, notching or bottle-necking the drill pipe thus was reduced to the bare minimum because the Duo-Matic System supports the drill string at its strongest point, the tool joint. Only two special elevators were used for all pipe handling operations . . . no slips were needed. Elevator links were automatically shifted between the two elevators to permit faster and safer handling of maximum pipe loads.

Ideco's Duo-Matic Dual Elevator System contributed to the success of the Mohole Project. It can also save your drill pipe from damage in the slip area in deep work. Ask your Ideco representative for full details.

IDECO

DIVISION OF DRESSER INDUSTRIES, INC.
P. O. Box 1331, Dallas 21, Texas

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Avail-able to Drwwks	Rated Depth with 4½" Pipe
King County						
E W Moran Drlg Co	8	dsl	750	Wlsn Roadaire	810	9,500
Kleberg County						
Allen & Morris Drlg Co	8	stm	1100	Emsco UB-LS-54	1200	12,000
Falco Drlg Co	1	gas	700	Brwstr N-45	450	7,500
	2	gas	1000	Ideco Spr 750	500	10,000
Lamar County						
Robert M Bass Drlg Contr	4	gas-LPG	350	Brwstr N-45	350	7,000
La Salle County						
Longhord Drlg Corp	*5	gas-btne	500	M-CSCO U-15	675	9,500
Lavaca County						
Harry T Bryant Drlg Co Ltd	4	gas-btne	—	Natl 75	1000	11,500
Edman Drlg Co	3	dsl	1000	M-CSCO U-15	900	10,000
Taylor Expl Co Inc	4	gaso	—	Mayhew	75	1,000
Appell Petroleum Corp	3	gas-gaso	510	Brwstr N-4	225	6,000
Sutton Drlg Co Inc	3	dsl	—	Brwstr N-4	350	8,200
Lee County						
Buzzini Drlg Co	10	gas-prop	1889	Wlsn Spr Titan	1880	16,000
Leon County						
B G Byars Power Drlg Co	3	dsl	400	Emsco GA-250-T	300	5,500
Carter-Jones Drlg Co	8	gas-btne	—	—	500	7,500
Gulley Long & Hedge Drlg Co Inc	*2	dsl	—	Wlsn Mogul	—	6,000
	*3	dsl	—	Beth Breeze	—	6,000
Maxwell Herring Drlg Corp	3	—	—	—	—	10,000
Liberty County						
Houston Oil Well Serv Co	2	dsl	—	Wlsn Titan	1000	10,000
Lipscomb County						
Arrow Drlg Co	9	gas	650	Emsco 500	—	8,000
Big Chief Drlg Co	33	gas	1250	Natl 55	1250	11,000
Dillard-Waltermire Inc	11	gas	900	Wlsn Gnt	1100	9,000
	15	gas	800	Wlsn Atlas	1200	11,000
Jack Grace Drlg Co	16	gas-btne	625	Wlsn Titan	1200	12,500
	20	gas-btne	625	Wlsn Atlas	1200	11,000
Helmerich & Payne Inc	7	gas	500	Emsco GB-500-82	700	9,000
Parker Drlg Co	47	gas	—	Natl 100	1400	14,000
Rayna Drlg Co	8	gas-btne	—	Beth MC-450	700	10,000
Service Drlg Co	*8	gas	320	M-CSCO U-34	320	6,700
Unit Drlg Co	*3	dsl	750	Natl 50-A	750	8,000
Wagner & Wyant Drlg Co Inc	2	dsl	500	M-CSCO U-15	675	9,000
Live Oak County						
Allen & Morris Drlg Co	7	dsl	1240	M-CSCO 75	1200	12,000
Harkins & Co	6	gas-gaso	675	M-CSCO U-15	675	9,500
Penrod Drlg Co	3	dsl	1850	Brwstr N-95	1490	13,500
Loving County						
Bickerstaff & Tibbets Drlg Co	*7	gas	—	Emsco G-36	450	5,500
Leatherwood Drlg Co	2	gas	440	Natl T-32	—	7,000
	3	dsl	220	Natl T-20	—	6,000
	7	gas	650	Natl 50	—	10,000
Lubbock County						
Sitton & Norton Drlg Co	*2	gas-btne	680	Natl 75	680	11,000
Thompson Expl Drlg Co	2	gaso	100	Failing 1500	100	1,500
	5	gaso	100	Failing 1500	100	1,500
Madison County						
Meadows & Walker Drlg Co	5	gas-btne	2062	Beth	1988	16,000
	6	gas-btne	2000	Beth	1800	16,000
Marion County						
Tex-Mex Drlg Co	7	gas	—	Emsco GB-350	—	7,500
Martin County						
Cactus Drlg Corp	3	gas	1485	Natl 80-B	1485	14,000
Norwood Drlg Co	7	gas-gaso	650	Wlsn	700	9,500
Parker Drlg Co	33	gas	—	Natl 75	1000	11,000
Matagorda County						
Appell Petroleum Corp	2	dsl	685	Frnks SG-101	400	8,500
Bay City Drlg Co	1	gas-btne	640	"Oilwell" T-52	450	8,500
	4	gas	727	Emsco G-500	640	10,000
Harry T Bryant Drlg Co Ltd	2	gas-btne	—	CT-5	800	9,000
Clegg & Hunt	7	dsl	—	Natl 75	880	11,000
Columbia Drlg Co	6	dsl	1060	Emsco GA-500	660	11,000
Edman Drlg Co	2	gas	1000	Brwstr N-75	900	12,000
Falcon Seaboard Drlg Co	11	stm	600	BIW Drdnut	600	17,000
Grey Wolf Drlg Co	4	gas-btne	780	Emsco GB-500	890	9,500
Hamman Oil & Ref Co	6	dsl	250	Brwstr N-4	310	6,500
Mac Drlg Co	7	stm	500	Natl 34-26	5000	10,000
	12	stm	500	Natl 23-9-FED	1000+	20,000
Lubie Martin Drlg Co	1	—	400	Brwstr N-4	450	6,000
Meadows & Walker Drlg Co	4	gas-btne	1455	"Oilwell" 76	1005	12,000
Neal Drlg Co	1	gas	1000	Natl 100	1000	13,500
Steen Drlg Co	1	stm	750	Emsco ECB	—	17,000
	3	gas-btne	700	Emsco J-750	1000	11,500
Carnes W Weaver Drlg Co	2	gas	900	Ideco M-10,000	200	12,500
Maverick County						
John W Voss Drlg Co Inc	3	gas	1400	Brwstr N-75	950	11,000
Midland County						
B B M Drlg Co	4	gas-btne	550	Natl 50	600	8,500/3½"
	8	gas-btne	1050	Beth M-58	700	9,000
O E Hall Drlg Co	5	gas	700	M-CSCO U-40	1210	12,000
Helmerich & Payne	43	gas	900	"Oilwell" 76	1100	11,000
Johnn Drlg Co	6	gas	850	Brwstr N-95	1300	14,000
Llano Drlg Co	2	gas	—	Natl 100	975	14,000
McDonald Drlg Co	1 FP3	dsl	—	Failing	350	2,000
	2 F250	gas	—	Serv water wells	—	400
Davey O'Brien Drlg Co Inc	1	gas-btne	700	Emsco GA-500	700	8,500
Parker Drlg Co	28	gas	—	Natl 50	700	9,000
Robinson Bros Drlg Co	1	gas	800	Brwstr N-75	800	10,000
Rowan Drlg Co Inc	28	gas-btne	1530	Natl 125	1530	16,000
Warton Drlg Co	2	gas	600	Natl 50	700	8,500
Mitchell County						
Tucker Drlg Co	1	gas	430	Brwstr N-55	495	8,500
Montague County						
Rayna Drlg Co	1	gas-btne	—	Wlsn Gnt	700	8,500
	2	gas-btne	—	M-CSCO U-15	700	8,500
C J Simpson Drlg Co	10	dsl-gas	—	Natl T-32	320	5,000
Moore County						
Service Drlg Co	10	gas or air	202	M-CSCO U-22	190	4,500
Nolan County						
Cooper Drlg Co	2	gas	600	Wlsn Gnt Rdair	600	9,000
Gilchrist Drlg Co	5	gas	500	Unit 15	500	7,500
Roy Guffey Drlg Co	3	gas-btne	440	M-CSCO U-34	235	5,500
	6	gas-btne	500	M-CSCO U-15	500	7,500
Sojourner Drlg Corp	11	btne	450	U-15	—	—
Thomas & Saxon Drlg Co	7	gas-btne	—	Wlsn Gnt	600	7,000
Nueces County						
Allen & Morris Drlg Co	5	gas-btne	780	OWSCO 76	900	12,000
Appell Petroleum Corp	4	gas-gaso	630	Crdwll	370	7,000
Dan L Clark Drlg Co	5	gas-btne	1025	Brwstr N-7	800	10,000
Columbia Drlg Co	Bge *7	dsl	750	MSCO U-15	450	8,500
Davis & Bates Inc	1	dsl	549	Brwstr N-4	460	7,500
J & C Drlg Co	*6	gas-btne	550	Natl 50	380	7,500
	8	gas-btne	810	Beth 650	810	12,500
Rhodes & Hicks Drlg Corp	1	gas-btne	370	Frnks 137	200	5,500
Storm Drlg Co	14	dsl barge	1800	Natl 75	900	12,000
Viking Drlg Co	5	gas	680	M-CSCO U-15	600	9,000
Yarborough Drlg Co	1	dsl	520	Wlsn Gnt	520	9,000
Ochiltree County						
Arrow Drlg Co	10	gas	650	Emsco 500	—	8,000
Dillard-Waltermire Inc	10	gas	600	Wlsn Gnt	800	8,000
FWA Drlg Co	8	—	—	—	—	9,000
	18	—	—	—	—	4,500
Falcon Seaboard Drlg Co	8	gas	900	Beth MC-450	900	10,000
	18	dsl	975	Wheland B-85	975	10,000
Foree Drlg Co	3	gas-btne	325	M-CSCO U-15	600	7,500
	5	btne	350	"Oilwell" 52-T	426	6,000
Jack Grace Drlg Co	5	gas-btne	500	Wlsn Atlas	700	10,000
	8	gas-btne	600	Wlsn Gnt	700	8,000
	11	gas-btne	600	Wlsn Gnt	700	9,000
Keating-Parker Drlg Co	11	gas-btne	1000	Beth MC-450	1000	11,000
Lynn Drlg Co	4	gas-btne	450	Natl 50	675	8,000
Moran Bros Inc	6	gas	900	Wlsn Gnt	750	9,500
	11	gas	900	Wlsn Gnt	750	10,000
Rayna Drlg Co	3	gas-btne	—	M-CSCO U-15	700	8,500
	4	gas-btne	—	M-CSCO U-15	700	8,500
Rowan Drlg Co Inc	10	gas-btne	1020	Beth 450	766	9,000
Service Drlg Co	12	gas	950	Wlsn Atlas	700	11,000
Wagner & Wyant Drlg Co Inc	1	dsl	300	M-CSCO U-15	675	8,000
	4	gas-btne	500	M-CSCO U-15	700	9,000
Panhandle County						
Spradling Drlg Co	1	gas	325	M-CSCO U-34	290	5,000
	2	gas	225	M-CSCO U-24	180	4,000
Panola County						
L & N Drlg Co	*1	btne	280	Brwstr N-3	160	3,500
Scooter's Drlg Serv	2	dsl	300	Brwstr N-4	300	4,500
	4	dsl	300	Brwstr N-45	500	6,000
Pecos County						
Alan Drlg Co	*2	gas	400	Wlsn Mogul	225	4,000
Bickerstaff & Tibbets Drlg Co	*2	gas	—	Brwstr N-4	320	5,500
	*4	gas	—	M-CSCO U-15	675	7,500
	*6	gas	—	M-CSCO U-15	675	8,500
Bolin Oil Co & D H Bolin	2	LPG or NG	250	Natl T-12	225	4,500
Capitan Drlg Co Inc	1	gas	700	Emsco GC-500	700	10,000
Delta Drlg Co	4	gas-btne	800	Natl 100	800	12,000
	6	gas-btne	800	Emsco J-750	750	9,500
Dixilyn Corp	6	dsl	2490	Natl 130	2490	16,000
Fortune Drlg Corp	1	gas	512	Beth S-55-C	512	7,500
Gardner Bros Drlg Co Inc	6	gas-btne	500	Natl 75	700	10,500
John Grappe Drlg Co	*2	gas	1700	Beth M-58	700	12,000

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Great Western Drlg Co	15	gas	1150	Natl 125	1200	20,000
	22	gas	1345	Natl 125	1500	20,000
	27	gas-gaso	853	M-CSCO U-914A	1340	18,000
	38	dsl	320	M-CSCO U-15	550	6,500
	44	dsl-elec	1400	M-CSCO U-1220	3000	25,000
Helmerich & Payne Inc	37	gas	1200	"Oilwell" 96	1450	15,000
Highland Drlg Co	2	gas	350	Ideco H-35	350	6,000
Johnn Drlg Co	5	gas	375	M-CSCO U-15	600	8,500
	9	gas	375	Brwstr N-45	400	7,000
E L Oliver Drlg Co	3	gas	200	Natl T-12 Trailer Mtd	185	3,000/4,000
Parker Drlg Co	4	gas	—	Natl 100	1400	14,000
	43	gas	—	"Oilwell" 96	1400	15,000
	45	gas	—	Natl 125	1400	15,000
	49	gas	—	Natl 125	1400	15,000
	65	gas	1200	Natl 100	1400	14,000
Raiborn Drlg Co	1	gas	200	Wichtex R-6	185	5,000
Rowan Drlg Co Inc	9	gas-btne	900	Natl 75	1110	11,000
Thompson Expl Drlg Co	1	dsl	184	Failing 2500	184	2,500
	12	gaso	100	Mayhew 1000	100	1,000
	13	gaso	100	Mayhew 1000	100	1,000
Polk County						
Columbia Drlg Co	8	dsl	1350	Ideco PR-1050	1350	17,000
Potter County						
Holt Bros Drlg Co	*2	dsl	270	Ideco H-20	270	4,000
Rains County						
M J Delaney Co	19	gas-btne	600	Emsco J-1250	1200	15,000
Reagan County						
Bolin Oil Co & D H Bolin	1	LPG or NG	250	Natl T-12	175	4,000
Real County						
Tucker Drlg Co	4	dsl	545	Beth S-55	840	10,500
Red River County						
Maxwell Herring Drlg Corp	4	gas	800	Wlsn Gnt Rdair	800	10,500
Reeves County						
Brantly Drlg Co Inc	5	gas	375	Emsco 250	250	4,000
Capitan Drlg Co Inc	2	gas	450	Emsco G-450	450	7,000
Delta Drlg Co	3	gas-btne	900	Natl 100	800	12,000
Helmerich & Payne Inc	39	gas	1100	"Oilwell" 96	1300	14,000
Parker Drlg Co	39	gas	—	Natl 100	1400	14,000
Refugio County						
Chiles Drlg Co	3	gas	500	Ideco H-40-D	460	8,500
J & C Drlg Co	2	stm	728	Ideal 34-32-9 DBM	525	10,000
	7	gas-btne	640	Emsco GB-500-34	645	9,000
Viking Drlg Co	1	dsl	475	Natl 50	500	8,500
Roberts County						
Lynn Drlg Co	5	gas-btne	725	Natl 75	900	10,500
Runnels County						
Frank Caraway Drlg Co	1	gas-btne	285	Beth S-50	265	5,000
	2	gas-btne	350	Wlsn Mogul Trcr	265	5,000
Cooper Drlg Co	1	gas	600	Wlsn Gnt	600	8,000
Gilchrist Drlg Co	2	dsl	450	Wlsn Gnt	450	5,800
Wes-Tex Drlg Co	7	btne	200	Brwstr N-3	225	3,000
Rusk County						
W Harlan Beene Drlg Co Inc	2	gas	685	Emsco GB-350	500	8,000
	3	gas	850	Emsco GB-500	870	11,000
Carter-Jones Drlg Co	6	gas-btne	—	—	350	6,800
	7	gas-btne	—	—	300	6,500
	10	gas-btne	—	—	500	7,000
	12	gas-btne	—	—	720	9,000
Delta Drlg Co	42	dsl	600	M-CSCO U-15	550	8,500
Gulley Long & Hedge Drlg Co Inc	4	gas-btne	—	Wlsn Gnt	—	8,000
Halbert Drlg Co	3	gas-btne	710	M-CSCO U-15	710	9,500
Tex-Mex Drlg Co	5	gas-btne	600	M-CSCO U-15	600	9,000
San Patricio County						
Boyd & Durst Drlg Contr	2	gas-btne	650	Wlsn Gnt	700	8,500
Dillard-Waltermire Inc	5	stm	800	Natl 23-9-FM	1000	12,000
Schleicher County						
Fortune Drlg Corp	2	gas	600	M-CSCO U-15	600	7,500
Hondo Drlg Co	6	gas	450	M-CSCO U-15	450	7,000
Shackelford County						
Gore Drlg Co	2	dsl	640	Beth 50	—	5,000
	3	gas	254	Joy 200-A	—	2,500/2⅞"
Oxford Drlg Co	2	dsl	325	Unit Rig Co U-15	600	7,500
	4	dsl	150	Wlsn-Mogul dbl drum	200	3,000
Shelby County						
W B Hinton	*2	dsl	550	M-CSCO U-15	650	8,000
Smith County						
B G Byars Power Drlg Co	2	gas-btne	1145	Emsco GA-500	750	10,500
Delta Drlg Co	9	gas-btne	936	Natl 100	800	12,000
	15	gas-btne	530	M-CSCO U-15	600	8,000

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Starr County						
Allen & Morris Drlg Co	2	stm	1100	BIW 12	1200	14,000
Harkins & Co	3	gas-gaso	850	M-CSCO U-15	850	10,000
Milam Drlg Co	1	gas-btne	600	Emsco G-500	600	8,000
Monte Cristo Drlg Corp	4	gas-btne	600	TIW CT-5	700	8,000
Well Drillers Inc	2	gas-btne	1446	Spr 7-11 Ideco	1446	15,000
Stephens County						
Ewing Drlg Co	1	btne	—	Emsco C-42	450	4,500
Gore Drlg Co	1	dsl	640	Shovel Spl	—	7,500
Low Drlg Co	1	btne	—	Emsco	290	7,000
Sterling County						
Thompson Expl Drlg Co	14	dsl	184	Failing 2500	184	2,500
Stonewall County						
Bolin Oil Co & D H Bolin	4	LPG or NG	350	Wlsn Rdair Gnt	350	7,500
FWA Drlg Co	4	—	—	—	—	7,000
W B Omohundro	10	btne	300	Wlsn Spr 38 Rdair	—	4,500/3½"
Sojourner Drlg Corp	1	btne	218	M-CSCO U-15	555	7,500
Wes-Tex Drlg Co	5	btne	550	Natl 50	550	7,500
Swisher County						
Norwood Drlg Co	3	gas-gaso	1050	Wlsn Titan	1050	12,500
	4	gas-gaso	500	Wlsn Gnt Rdair	600	9,500
Taylor County						
Gilchrist Drlg Co	1	gas	290	Emsco G-36	290	5,500
	7	gas	145	Wlsn Super	145	3,500
Hack Drlg Co	1	btne	—	M-CSCO U-15	412	8,500
	4	btne	—	—	161	2,500
Sojourner Drlg Corp	3	dsl	550	M-CSCO U-15	520	7,500
	4	btne	225	M-CSCO U-34	225	4,500
	5	btne	225	Natl T-8-S	145	3,250
Terrell County						
Great Western Drlg Co	18	dsl	955	M-CSCO U-914A	1800	18,000
Parker Drlg Co	63	gas	1200	Natl 100	1400	14,000
Rowan Drlg Co Inc	16	gas-btne	504	Natl 50	660	8,500
	25	gas-btne	1260	Natl 100	1680	14,000
Throckmorton County						
Alan Drlg Co	*1	gas	500	Wlsn Gnt	600	7,500
Man Drlg Co	*5	gas	350	Wlsn Gnt	225	5,500

Use a compound that has been developed especially for the oil industry . . . Rectorseal #5. It is your best assurance of leak-proof connections on casing, tubing, flow lines, wellheads, heater, treater, separator, tank and other oil field installations. Best also on your secondary recovery piping and LPG underground storage facilities — it's insoluble in LP gas.

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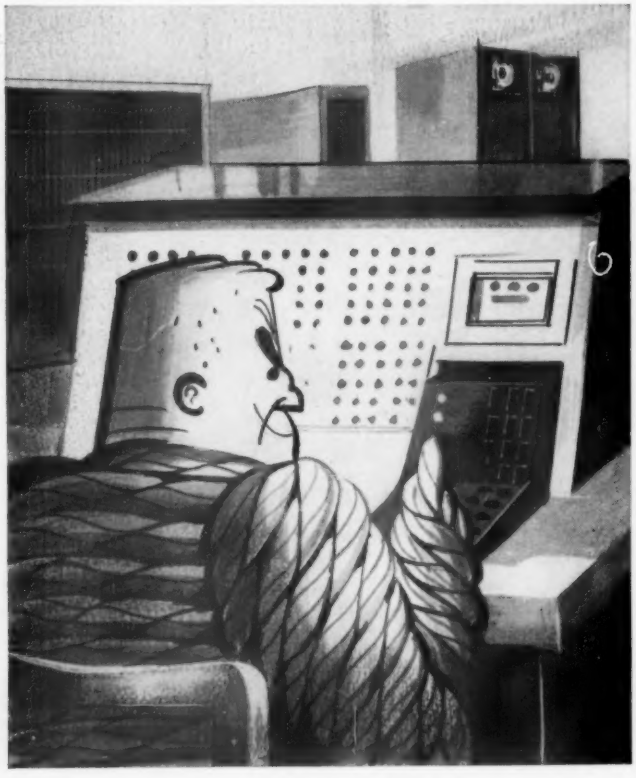

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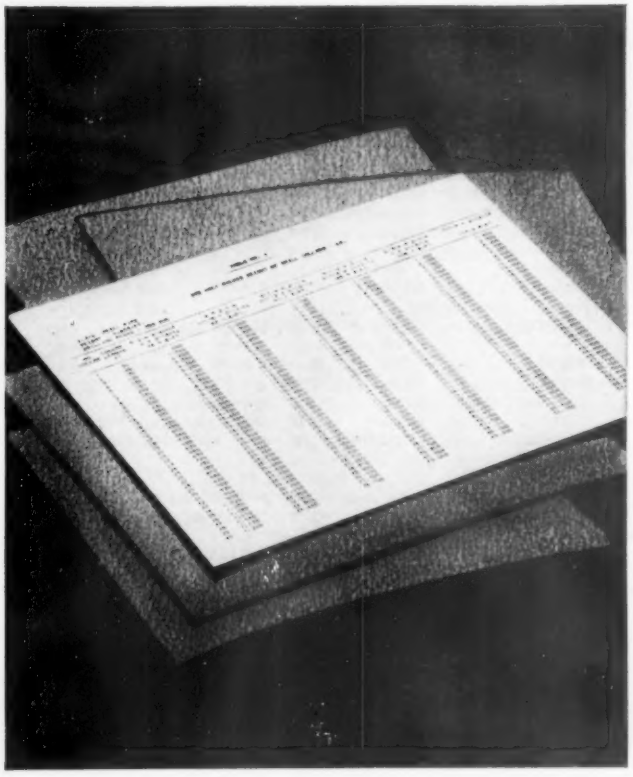
any drilling situation

From 600,000 Calculations Made by "705" Electronic Brain



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New Personal Field Service comes with Union's improved Electronic Cut-Off Procedure. Just outline your drilling plans. A qualified Union field man will bring the specific charts you need, and explain their use to you and your entire crew. **Write Union Wire Rope, Armco Steel Corporation, 2106 Manchester Ave., Kansas City 26, Mo.**

ARMCO Union Wire Rope

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
R-G Drlg Co	1	gas-gaso	—	Wisn	650	6,500
	3	gas-gaso	—	Wisn	450	6,500
	5	gas-gaso	—	Wisn	650	8,000
Tom Green County						
Herb Expl Co	2	btne	—	Failing 1500	—	1,500/2⅛"
	3	btne	—	Failing 1500	—	1,500/2⅛"
Tucker Drlg Co	2	gas	430	Brwstr N-4	330	6,000
	3	gas	540	Ideco TC-600	495	10,500
Tyler County						
Clegg & Hunt	2	stm	—	Emsco H-54	—	11,000
Thompson Expl Drlg Co	8	gaso	100	Failing 1500	100	1,500
Upshur County						
Robert M Bass Drlg Contr	2	gas-LPG	300	Wisn Gnt	300	5,500
Upton County						
Cactus Drlg Corp	9	gas	1185	Brwstr N-75	1185	12,000
E B Clark Drlg Co	1	gas-btne	750	Emsco G-500	600	7,500
Delta Drlg Co	36	gas-btne	900	Wisn Titan	900	15,000
Dixilyn Corp	4	gas	950	Natl 80	950	14,000
	3	gas	950	Natl 100	950	14,000
Valverde County						
Helmerich & Payne Inc	48	gas-btne	1200	Natl 110	1300	15,000
Van Zandt County						
Arrow Drlg Co	5	gas	1250	Emsco	—	14,000
M J Delaney Co	28	gas-btne	500	"Oilwell" 96	1000	14,000
W B Hinton	*3	dsl	500	M-CSCO U-15	900	9,000
Tex-Mex Drlg Co	10	gas	—	Emsco GB-500	—	9,000
Victoria County						
E L Bass Drlg Co	3	rotary	—	M-CSCO U-34	—	7,000/3½"
Dan L Clark Drlg Co	2	gas-btne	1000	Emsco GC-500	500	7,500
Glenn Drlg Co	3	gas	145	Crdwll S	145	4,000
A J Kuenstler Drlg Co	1	dsl	300	Wisn Super Gnt	300	7,500
Waller County						
Dillard-Waltermire Inc	2	dsl	1800	Natl 125	2400	16,000
Ward County						
Bolin Oil Co & D H Bolin	7	LPG or NG	250	Beth S-50	225	4,000
Dillard-Waltermire Inc	12	gas	600	Wisn Gnt	800	8,000
John Grappe Drlg Co	*1	gas	1400	Beth S-60	700	8,000
Great Western Drlg Co	11	dsl	353	Wisn Gnt Rdmstr	900	9,000
H T Porter Drlg Co	1	gas	300	Natl T-20	250	4,500
	3	gas	500	Natl 50	500	6,500
Texas Drlg Co	2	dsl	427	Brwstr N-4	300	4,500
Webb County						
Storm Drlg Co	2	dsl	1400	Natl 80	900	12,000
Wharton County						
Big "6" Drlg Co	3	gas-btne	500	Crdwll Tlrg	500	7,500
Sutton Drlg Co Inc	10	dsl	—	Beth S-55	875	12,000
Wheeler County						
Service Drlg Co	*11	gas	160	AH-Trailer	140	3,000
Wichita County						
FWA Drlg Co	15	—	—	—	—	3,000
	17	—	—	—	—	3,500
H O Grace Drlg Co	3	btne	—	—	—	6,000
	4	btne	—	—	—	7,500
Hull Oil Co	1	btne	140	Wlkr-Nr R-2	135	2,150
E W Moran Drlg Co	6	gas	225	Wisn Mogul	160	4,500
W B Omohundro	9	btne	550	Wisn Gnt	—	5,500
R-G Drlg Co	2	gas-gaso	—	Wisn	650	8,000
Wilbarger County						
FWA Drlg Co	6	—	—	—	—	4,500
Willacy County						
J C Bickham Drlg Co Inc	*9	gas	800	Hou Prtble CT-5	500	8,500
Winkler County						
Cactus Drlg Co	2	gas	395	Brwstr N-4	496	6,000
	11	gas	395	Brwstr N-4	496	6,000
Camden Drlg Co	1	dsl	300	Natl T-20	300	5,000
Danforth Drlg Co	1	dsl	320	Ideco H-30	350	5,000
FWA Drlg Co	3	—	—	—	—	10,000
	10	—	—	—	—	5,000
Johnn Drlg Co	3	gas	650	Wisn Atlas	900	10,000
King-Phillips Inc	3	dsl	622	Ideco H-40-D	—	5,500/4"
Leatherwood Drlg Co	4	gas	450	Crdwll	450	6,000
	5	gas	520	Wisn Gnt Rdair	—	6,000
	8	dsl	1500	Super 7-11	—	15,000
Llano Drlg Co	3	gas	1200	Natl 100	975	14,000
Parker Drlg Co	42	gas	—	Natl 100	1400	14,000
Pico Drlg Co	5	gas-btne	356	"Oilwell"A-64-B	356	6,000
Texas Drlg Co	1	gas	300	Natl T-20	300	5,000/3½"
Tri-Service Drlg Co	8	gas	900	"Oilwell" 76	900	10,000
Wise County						
John W Harris Drlg Co	2	gas	500	Emsco GC-500	500	8,000
Bolin Oil Co & D H Bolin	6	LPG or NG	350	Wisn Rdair Gnt	250	6,500
Gateway Petro Co Inc	2	gas	—	U-15	—	7,000
E W Moran Drlg Co	1	gas	500	M-CSCO U-15	560	7,500
Trio Drlg Co	1	gas	520	Natl 50	—	6,500
	2	gas	520	Natl 50	—	6,500
	3	gas	450	Natl 50	—	6,500
	4	gas	450	Natl 50	—	6,500
Walters Drlg Co Inc (Dallas)	12	dsl	—	Mayhew 1000	300	400/2⅛"
Wood County						
Ace Drlg Co	2	gas-btne	500	Emsco G-500	630	9,000
Delta Drlg Co	22	gas-btne	530	M-CSCO U-15	600	8,000
Maxwell Herring Drlg Corp	2	—	—	—	—	11,000
Parker Drlg Co	44	gas	—	Natl 125	1400	15,000
Trant Drlg Co	3	dsl	1000	U-15	1000	10,000
Yoakum County						
Arrow Drlg Co	30	gas	650	Emsco 500	—	8,000
Drlg & Expl Co of Del Inc	14	gas-elec	1100	Natl 34-10	1000	17,000
Durham Drlg Co Inc	1	gas	650	Unit U-15	650	8,000
Gardner Bros Drlg Co Inc	8	gas-btne	500	Natl 50	675	7,000
Great Western Drlg Co	2	gas-gaso	500	Wisn Gnt Rdwstr	840	9,000
O E Hall Drlg Co	3	gas	600	M-CSCO U-15	700	8,000
Moran Oil Prod & Drlg Corp	3	gas	750	M-CSCO U-15	800	8,500
Rowan Drlg Co Inc	12	gas-btne	1260	Natl 100	1680	14,000
Young County						
Anderson Drlg Co	1	btne	225	Wisn Mogul	—	4,000
Bolin Oil Co & D H Bolin	9	LPG or NG	225	Wisn Super	175	3,500
Jess P Cross Drlg Contr	*1	gas-btne	225	Wisn Mogul	200	4,800
R W Durden Drlg Co	1	gas	145	Wichtex R-3	140	3,000
Gene McCutchin Drlg Co	*5	gas	275	Wisn Gnt	275	5,500
H O Grace Drlg Co	1	btne	—	—	—	6,000
Oney Drlg Co	*5	LPG	200	Crdwll "S"	166	4,500
Zapata County						
Longhorn Drlg Corp	*4	gas-btne	500	M-CSCO U-15	675	9,500
	*6	gas-btne	700	"Oilwell" 76	1185	14,000
Storm Drlg Co	1	dsl	1800	Natl 110	1200	15,000
John W Voss Drlg Co Inc	1	gas	1200	Brwstr N-75	912	11,000
	2	gas	750	Brwstr N-7	750	8,500
	4	gas	1600	Natl 100	1400	16,000
Well Drillers Inc	1	gas-btne	1446	Brwstr N-95	1446	16,000
UTAH						
Duchesne County						
Kerr-McGee Oil Ind Inc	1	gas	825	M-CSCO U-15	832	10,000
Will I Lewis Drlg Co	5	dsl	1200	"Oilwell" 76	1200	13,500
Emery County						
Arapahoe Drlg Co	6	gas-btne	1320	Natl 80-B	1320	14,000
Willard Pease Drlg Co	2	dsl	600	Mayhew	600	7,000
Garfield County						
Mountain States Drlg Co Inc	3	gas-dsl	600	Natl 50-A	—	7,500
	11	gas-dsl	1000	Natl 80-B	—	12,500
Grand County						
Camay Drlg Co	3	gas	1050	Natl 75	950	11,000
Camay Drlg Co Rocky Mt Div	4	gas-btne	1275	Natl CA-75	950	10,000
Willard Pease Drlg Co	3	prop	—	Grdnr Den	600	9,000
San Juan County						
Great Western Drlg Co	36	gas-gaso	320	M-CSCO U-15	675	7,500
R L Manning Co	4	gas-btne	600	Emsco 450	450	7,000
Moran Bros Inc	4	gas	1000	Wisn Titan	1200	14,000
	8	gas	1100	"Oilwell" 66	1000	12,000
Mountain States Drlg Co Inc	6	dsl	600	Natl 50	—	7,500
	17	dsl	540	Natl T-32	—	6,000
Rutledge Drlg Co	*2	gas-btne	650	Beth M-58	850	10,000
	*5	gas-btne	692	Natl 50	500	8,000
	*7	gas-btne	356	M-CSCO U-15	555	8,000
San Pete County						
Arapahoe Drlg Co	7	gas-btne	700	Natl T-45	700	8,500
Pioneer Drlg Co Inc	*5	dsl	960	Emsco J-750	960	14,000
Uintah County						
Arapahoe Drlg Co	8	gas-btne	375	Natl T-32	375	6,000
Calvert Drlg Inc	15	dsl	260	Ideco H-35	260	7,000/3½"
	20	dsl	350	Ideco H-525	600	8,500
	23	dsl	350	Ideco H-525	600	8,500
Delta Drlg Co	50	gas-btne	800	Beth S-60	480	8,000
Hose-Austin Drlg Corp	3	gas	650	M-CSCO U-15	650	8,000
Kerr-McGee Oil Ind Inc	23	gas	650	Natl 50	556	9,000
WEST VIRGINIA						
Lewis County						
S W Jack Drlg Co	4	gas	1000	M-CSCO U-15	1000	10,000
Pocahontas County						
Delta Drlg Co	39	gas-btne	500	Natl 75	1000	9,500
Preston County						
Delta Drlg Co	27	dsl	380	Emsco GA-350	350	6,000
	29	dsl	750	Emsco J-750	750	12,000
WYOMING						
Big Horn County						
Big Horn Drlg Co Inc	1	dsl	320	Brwstr N-4	290	5,500
Will I Lewis Drlg Co	6	dsl	1600	M-CSCO U-20	1600	14,000

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
R L Manning Co	18	gas-btne	375	Emsco GB-250-T	440	6,500
Campbell County						
Circle "A" Drlg Co Inc	9	gas	600	Natl 50-A	650	8,500
Donnell Drlg Co	10	gas-btne	700	Beth M-58	700	8,000
Exeter Drlg Co	1	dsl	800	Natl 50-A	800	8,500
	5	dsl	300	Natl T-32	300	6,500
Pioneer Drlg Co Inc	*3	dsl	960	Emsco GA-500	640	10,000
	*4	dsl	960	Emsco GB-500	640	10,000
Signal Drlg & Expl Inc	8	gas	250	Natl 50	700	8 000
Tradewinds Drlg Co	5	dsl	—	Emsco GA-250-T	290	6,500
	*8	gas-btne	—	M-CSCO U-15	750	8,500
True Drlg Co	11	gas-LPG	1100	Natl 75	1100	11,000
	12	gas-LPG	1200	Wlsn Gnt	800	13,000
Carbon County						
Delta Drlg Co	18	dsl	600	Natl 75	650	9,500
Falcon Seaboard Drlg Co	9	gas	480	M-CSCO U-15	480	8,500
Mountain States Drlg Co Inc	2	gas-dsl	1000	Emsco J-750	—	10,000
Rowan Drlg Co Inc	5	gas-btne	505	Natl 75	1010	11,000
Tradewinds Drlg Co	6	dsl	—	Frnks TD-44	220	3,500
True Drlg Co	14	gas-LPG	1000	Natl 50-A	700	9,500
Converse County						
Big Horn Drlg Co Inc	3	dsl	500	Emsco GB-250	500	7,500
Bueno Drlg Co	1	dsl	—	Natl 50-A	675	7,000
Circle "A" Drlg Co Inc	11	gas	600	Wlsn Gnt Rdair	650	9,000
Dyer Drlg Co	2	gas	650	M-CSCO U-15	650	9,000
	3	gas	400	Wich-C-60-HD	400	—
	*4	dsl	200	Failing 60	148	3,000
	*6	dsl	—	Wlsn-Torcair	225	—
Crook County						
Delta Drlg Co	23	dsl	520	Emsco GA-500	500	8,000
Garvey Drlg Co	17	dsl	300	Wlsn Rdair	450	7,000/3½"
Lohmann-Johnson Drlg Co Inc	4	dsl	300	M-CSCO U-15	440	5,500
Fremont County						
Carmack Drlg Co	8	dsl	400	Natl D-300	300	5,000
Delta Drlg Co	48	gas-btne	310	Beth S-60	450	7,000
Fitzpatrick Drlg Co Inc	4	gas-btne	900	Wlsn Titan Rdair	900	12,500
Kerr-McGee Oil Industries Inc	31	gas	1000	Natl 100	1680	15,000
R L Manning Co	6	gas-btne	900	Emsco GB-800	1125	11,000
	8	dsl	550	Emsco G-500	550	7,500
	10	gas-btne	1275	Emsco J-750	1125	11,000
Rowan Drlg Co Inc	31	gas-btne	1150	Natl 75	1150	11,000
Signal Drlg & Expl Inc	5	gas-btne	1400	Natl 80	1200	14,000
Sprecher Drlg Corp	4	dsl	1000	Natl 80-B	1000	14,000
Hot Springs County						
Arrow Drlg Co	14	dsl	400	Emsco 250	—	6,000
Circle "A" Drlg Co Inc	10	dsl	500	Brwstr N-55	500	8,500
Dyer Drlg Co	1	gas	350	Natl T-32	300	6,000
True Drlg Co	*7	dsl	350	Failing 66	185	3,000
Johnson County						
R L Manning Co	17	gas-btne	765	Emsco GC-500	840	10,000
Natrona County						
Fitzpatrick Drlg Co Inc	6	dsl	300	Natl T-12-S	300	4,500
Gabe McCall Drlg Co	2	gas	850	Natl T-45	850	10,000
R L Manning Co	11	gas-btne	1080	Emsco J-1000	1305	13,000
Signal Drlg & Expl Inc	9	gas	250	Brwstr N-45	500	7,000
Sprecher Drlg Corp	2	dsl	900	Emsco J-750	900	10,500
	6	dsl	750	Emsco A-550	750	10,000
Niobrara County						
A L Schlaikjer	1	gas	800	Wlsn Gnt Rdair	800	8,500
True Drlg Co	*4	gas-LPG	650	Emsco 250	400	6,000
Park County						
C E Brehm Drlg & Prod	W 3	gas	532	Wlsn Mogul Spr	532	7,200
Delta Drlg Co	52	gas-btne	310	Beth S-50	225	5,500
R L Manning Co	5	gas-btne	750	Emsco G-500	750	8,000
	16	gas-btne	650	Natl T-32	450	6,000
Signal Drlg & Expl Inc	3	dsl	475	M-CSCO	500	7,500
True Drlg Co	10	gas-LPG	1000	M-CSCO U-15	675	8,500
Sublette County						
Fitzpatrick Drlg Co Inc	1	gas-btne	550	M-CSCO U-15	550	8,250/4"
Signal Drlg & Expl Inc	2	dsl	475	M-CSCO	500	7,500
	10	gas	250	Emsco G-500	785	8,500
True Drlg Co	9	gas-LPG	1200	M-CSCO U-40	1200	13,000
Sweetwater County						
Camay Drlg Co Rocky Mt Div	3	dsl	560	Natl 50-A	450	8,500
Circle "A" Drlg Co Inc	8	gas	600	Unit U-15	650	8,500
Fitzpatrick Drlg Co Inc	5	gas-btne	600	Natl 50-A	600	8,500
Falcon Seaboard Drlg Co	39	gas	770	Emsco G-500	770	9,000
	43	dsl	300	Beth S-55	325	6,500
Sprecher Drlg Corp	5	dsl	350	Brwstr N-45	350	6,500
Tradewinds Drlg Co	1	dsl	—	Emsco GA-350	615	7,500
True Drlg Co	15	gas-LPG	1000	Natl 50-A	700	9,500
Uinta County						
Pioneer Drlg Co Inc	*6	dsl	960	Emsco GB-800	960	14,000
Washakie County						
Delta Drlg Co	51	gas-btne	725	Natl 75	600	9,000
R L Manning Co	15	dsl	540	Emsco GB-250	340	6,000
Weston County						
Delta Drlg Co	49	gas-btne	725	Unit U-15	600	8,000
Garvey Drlg Co	19	dsl	300	Wlsn Rdair	450	7,000/3½"
Lewis Bros Inc	1	dsl	450	M-CSCO U-15	550	9,000
Murfin Drlg Co	5	dsl	500	Emsco C-500	600	8,000
Prairie Drlg Co Inc	1	gas	—	Crdwll RL Spdr	200	11,000

Canadian Rotary Drilling Contractors

Bawden Peter Drlg Ltd 640 Seventh Ave Calgary Alberta Canada
Big Horn Drlg Ltd 6530 100th St Edmonton Alberta Canada
Big Indian Drlg Co Ltd 216 Blow Bldg 513 8th Ave W Calgary Alberta Canada
Border Drlg Co Ltd Box 40 Lloydminster Alberta Canada
Brinkerhoff Drlg Co Ltd 1001 Mobil Oil Bldg Calgary Alberta Canada
Cactus Drlg Corp Ltd Box 853 Calgary Alberta Canada
Can American Drlg Ltd 320 Seventh Ave W Calgary Alberta Canada
Can-Tex Drlg Co Ltd 239 Sixth Ave W Calgary Alberta Canada
Canbridge Corp Ltd 237-7 Ave W Calgary Alberta Canada
Cascade Drlg Co Ltd 330 Ninth Ave SW Calgary Alberta Canada
Central Del Rio Oils Ltd Drlg Div 224 9th Avenue W Calgary Alberta Canada
Charter Drlg Co Ltd 111 Petroleum Bldg Calgary Alberta Canada
Chupp Well Serv Ltd 525 A 7th Ave SW Calgary Alberta Canada
Commonwealth Drlg Co Ltd 122 Eighth Ave W Calgary Alberta Canada
Coultis Drlg Ltd 1724 Suffolk St Calgary Alberta Canada
Duke Drlg Co Ltd 239 Eighth Ave W Calgary Alberta Canada
Garnder Bros Drlg Co Ltd 309 7th Ave SW Calgary Alberta Canada
Gustavson Drlg Co Ltd 203 Empire Bldg Calgary Alberta Canada
Hi-Tower Drlg Co Ltd 400 Lancaster Bldg Calgary Alberta Canada
Hunter Drlg Ltd 602 Seventh Ave W Calgary Alberta Canada
Kenyon's Drlg & Serv Co Ltd 10439 82nd Ave Edmonton Alberta Canada
L & J Drlg Ltd 7 Empire Bldg Calgary Alberta Canada
Lohmann-Johnson Drlg Co Ltd 208 Bamlett Bldg Calgary Alberta Canada
Parker Drlg Co of Canada Ltd 440 Bentall Bldg Calgary Alberta Canada
Pennant Drlg Co Ltd 930 Elveden House Calgary Alberta Canada
Petrolia Drlg Co Ltd 1410 4th St SW Calgary Alberta Canada
Porter Drlg Ltd 304 Brent Bldg Regina Saskatchewan Canada
Precision Drlg Co Ltd 1134 Eighth Ave W Calgary Alberta Canada
Reading & Bates Drlg Co Ltd 3rd Floor Royal Bk Bldg Calgary Alberta Canada
Regent Drlg Co Ltd Box 421 Edmonton Alberta Canada
Rine Drlg Co of Canada Ltd 528 8th Ave SW Calgary Alberta Canada
Ryland Drlg Ltd Box 608 Edmonton Alberta Canada
S & T Drlg Co Ltd 10852 82nd St Edmonton Alberta Canada
Tri-City Drlg Co Ltd Box 2347 11903 Kingsway Ave Edmonton Alberta Canada
Trinity Canadian Drlg Co 1001 F R Webster Bldg 237 Seventh Ave W Calgary Alberta Canada

Canadian Contract ROTARY Drilling Rigs

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
(Undesignated)		**ALBERTA**				
Canamerican Drlg Corp Ltd	*2	dsl	600	Natl 55	975	10,000
	*3	dsl	1200	Natl 110	1600	15,000
Gardner Bros Drlg Co Inc	15	gas-btne	1000	"Oilwell" 96	1300	10,000
Aldersyde						
Precision Drlg Co Ltd	7	dsl	550	Ideco 525-D	550	8,000

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Alix						
Canbridge Corp Ltd	6	dsl	420	Emsco GB-350	420	7,500
Ardley						
Canbridge Corp Ltd	11	dsl	300	Emsco G-300	300	6,000
Barrie Lake						
Commonwealth Drlg Co Ltd	6	dsl	690	Ideco M-750	600	8,500
Beaverhill Lake						
Big Horn Drlg Ltd	3	dsl	300	Crdwll 1-350	300	4,500
Bistchko Lake						
Commonwealth Drlg Co Ltd	17	dsl	630	Emsco GB-350	720	6,000
Blackie						
Hi-Tower Drlg Co Ltd	10	dsl	755	"Oilwell" 76	1000	12,000
Brooks						
Precision Drlg Co Ltd	11	dsl	550	Crdwll D	550	6,000
Buck Creek						
Cascade Drlg Co Ltd	3	dsl	275	Natl 50	275	6,500
Calgary						
Gustavson Drlg Co Ltd	1	dsl	500	Natl 50	500	7,500
	3	dsl	275	Ideco H-40	300	6,500
Carbondale						
Brinkerhoff Drlg Co Ltd	27	dsl	850	Natl 100	1270	13,500
Caribou Mountain						
Precision Drlg Co Ltd	3	dsl	278	Ideco H-30-D	350	5,500
	4	dsl	276	Natl T-20	350	5,500
	14	dsl	278	Natl T-12	350	4,500
Caroline						
Regent Drlg Co Ltd	6	dsl	750	Brwstr N-75	780	10,000
	30	dsl	260	Ideco H-40	260	6,000
Carson Creek						
Gustavson Drlg Co Ltd	4	dsl	850	Natl 55	850	10,000
Parker Drlg Co of Can Ltd	13	dsl	840	Crdwll "OA"	840	9,000
Pennant Drlg Serv Ltd	5	dsl	1050	M-CSCO U-40	900	11,500
Carson Lake						
Commonwealth Drlg Co Ltd	19	dsl	735	Natl 50-A	790	9,500
Central						
Jennings Drlg Co (Alberta) Ltd	1	dsl	300	Beth C-50	300	6,000
	2	dsl	300	Beth C-50	300	6,000
	3	dsl	880	M-CSCO U-15	880	9,000
Cessford						
Precision Drlg Co Ltd	5	dsl	278	M-CSCO U-34D	350	5,000
Chip Lake						
Commonwealth Drlg Co Ltd	11	dsl	260	Ideco H-40D	300	5,500
Coalspur						
Peter Bawden Drlg Ltd	21	dsl	1680	"Oilwell" 96	1680	18,000
Cochrane						
Parker Drlg Co of Can Ltd	9	dsl	1260	Natl 110	1890	16,000
Coronation						
Rine Drlg Co of Canada Ltd	3	dsl	220	Crdwll L Tri	248	4,000
Coutts						
Canbridge Corp Ltd	*5	dsl	200	Crdwll L	200	4,500
Gardner Bros Drlg Co Ltd	15	dsl	1600	"Oilwell" 96	200	18,000
Crossfield						
Can Tex Drlg & Expl Ltd	4	dsl	900	Crdwll O	900	8,500
Commonwealth Drlg Co Ltd	8	dsl	690	Brwstr N-7	600	8,000
Parker Drlg Co of Can Ltd	5	dsl	420	Natl 50	420	7,000
Commonwealth Drlg Co Ltd	9	dsl	1020	Ideco 700	940	10,000
	26	dsl	1275	Natl 80-B	1410	12,000
Cynthia						
Cascade Drlg Co Ltd	9	dsl	275	Natl T-32	275	5,500
Deer Mountain						
Regent Drlg Co Ltd	28	dsl	500	Natl 50-A	520	7,500
Devon						
Ryland Drlg Ltd	2	dsl	670	Natl 50	690	7,500
Drayton Valley						
Cascade Drlg Co Ltd	10	dsl	550	Natl 50	550	6,500
Petrolia Drlg Ltd	7	dsl	250	Natl 50	365	7,500
	10	dsl	300	M-CSCO U-34D	300	5,500
Ryland Drlg Ltd	1	dsl	600	Emsco 450	640	7,500
Drumheller						
Cascade Drlg Co Ltd	6	dsl	275	Natl T-20	192	4,500
	16	dsl	275	M-CSCO U-34	275	5,000
Eaglesham						
Parker Drlg Co of Can Ltd	10	dsl	500	Natl 50-A	700	7,500
Edmonton						
Peter Bawden Drlg Ltd	4	dsl	227	Crdwll RL	210	4,500
Big Indian Drlg Co Ltd	6	gas	—	Mayhew	—	2,000/2⅝
Cascade Drlg Co Ltd	8	dsl	556	Natl 50	556	6,500
Tri-City Drlg Co Ltd	1	dsl	180	Failing 2500	180	2,500
Edson						
Gardner Bros Drlg Co Ltd	7	dsl	970	Natl 75	1000	13,000
Etzikom						
Precision Drlg Co Ltd	1	dsl	278	Ideco H-30-D	350	5,500
	10	dsl	280	Ideco 525-D	650	8,000

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Fox Creek						
Gustavson Drlg Co Ltd	6	dsl	1000	Emsco A-550	1000	11,000
Garrington						
Brinkerhoff Drlg Co Ltd	12	dsl	300	Natl T-32	300	6,000
Gilby						
Peter Bawden Drlg Ltd	5	dsl	454	Natl T-32	278	6,500
	23	dsl	405	Emsco GB-350	405	7,000
Commonwealth Drlg Co Ltd	3	dsl	690	Natl 50	600	6,500
	14	dsl	580	Ideco H-40D	660	5,500
Grand Prairie						
Can Tex Drlg & Expl Ltd	9	dsl	700	Emsco 500	700	8,500
Cascade Drlg Co Ltd	12	dsl	1350	Natl 80-B	1350	14,000
Trinity Canadian Drlg Co	4	dsl	990	Natl 80-B	990	12,000
Grourard						
Duke Drlg Co Ltd	2	dsl	650	Natl 50	650	8,000
Halkirk						
Double-A Drlg Co Ltd	13	dsl	320	Ideco H-40	300	6,500
Harmatton						
Cactus Drlg Corp Ltd	5	dsl	600	Emsco GB-500	600	8,500
Commonwealth Drlg Co Ltd	28	dsl	920	Natl 55	1000	10,000
Hi-Tower Drlg Co Ltd	9	dsl	285	Crdwll D	300	5,000
Hilleard						
Ryland Drlg Ltd	3	dsl	320	Natl T-32	320	6,000
Hussar						
Cactus Drlg Corp Ltd	4	dsl	215	Emsco GB-160	275	4,000
Judy Creek						
Peter Bawden Drlg Ltd	2	dsl	870	Natl 55	870	10,000
Brinkerhoff Drlg Co Ltd	18	dsl	625	Emsco GC-500	846	10,000
Commonwealth Drlg Co Ltd	27	dsl	870	Natl 50-A	660	9,000
Duke Drlg Co Ltd	8	dsl	500	M-CSCO U-40	670	11,500
Hi-Tower Drlg Co Ltd	3	dsl	525	"Oilwell" 66	600	8,000
Parker Drlg Co of Can Ltd	7	dsl	600	Natl 55	670	9,000
Pennant Drlg Serv Ltd	1	dsl	1050	M-CSCO U-40	775	11,500
	4	dsl	1000	Crdwll O	650	9,500
Regent Drlg Co Ltd	24	dsl	720	Brwstr N-7	520	9,000
S & T Drlg Co Ltd	3	dsl	600	Natl 55	1083	9,000
Jumping Pound						
Duke Drlg Co Ltd	6	dsl	850	M-CSCO U-20	1386	15,000
Kaybob						
Peter Bawden Drlg Ltd	26	dsl	834	"Oilwell" 76	834	11,500
Canbridge Corp Ltd	*3	dsl	380	Crdwll Trailerig	380	6,000
Duke Drlg Co Ltd	5	dsl	700	M-CSCO U-20	1386	15,000
Hi-Tower Drlg Co Ltd	8	dsl	570	M-CSCO U-15	600	8,000
Kinsella						
Commonwealth Drlg Co Ltd	25	dsl	425	M-CSCO U-34-D	300	5,500
Langdon						
Hi-Tower Drlg Co Ltd	2	dsl	600	Crdwll "O"	700	8,000
Leduc						
Can Tex Drlg & Expl Ltd	8	dsl	300	Natl 25	300	6,000
Lloydminster						
Border Drlg Co Ltd	1	dsl	175	Crdwll L	150	3,500
Lobstick						
Brinkerhoff Drlg Co Ltd	16	dsl	370	Emsco GA-350	450	7,500
Lomond						
Hunter Drlg Ltd	3	dsl	450	Crdwll	260	6,000
Lookout Butte						
Brinkerhoff Drlg Co Ltd	21	dsl	850	Emsco GB-800	1269	13,500
Looma						
Cactus Drlg Corp Ltd	7	dsl	600	Emsco GB-350	600	7,500
Mahon Creek						
Peter Bawden Drlg Ltd	18	dsl	1290	Natl 100	1290	13,000
Mazy						
Double-A Drlg Co Ltd	11	dsl	320	Ideco H-30	300	5,000
Milo						
Commonwealth Drlg Co Ltd	7	dsl	750	Natl 50	530	6,500
Morinville						
Big Horn Drlg Ltd	1	dsl	300	Crdwll S-350	300	5,000
Nordegg						
Can Tex Drlg & Expl Ltd	12	dsl	1200	Emsco 800	1200	14,000
Nosehill Creek						
Brinkerhoff Drlg Co Ltd	22	dsl	900	Natl 110	1450	15,000
Oyen						
Precision Drlg Co Ltd	2	dsl	278	Ideco H-20-D	350	3,500
Paddle Creek						
Cascade Drlg Co Ltd	1	dsl	550	Natl 50	550	7,500
Double-A Drlg Co Ltd	12	dsl	800	Ideco H-525	530	9,000
Panther River						
Peter Bawden Drlg Ltd	10	dsl	1120	Natl 80-B	1120	14,000
Parkland						
Regent Drlg Co Ltd	10	dsl	480	Unit 36	480	8,500
Pembina						
Peter Bawden Drlg Ltd	11	dsl	278	Natl T-32	278	6,500
	12	dsl	278	Natl T-12	194	4,000

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Cactus Drlg Corp Ltd	1	gas-btne	450	Brwstr N-55	450	7,000
Commonwealth Drlg Co Ltd	10	dsl	550	Ideco H-35-D	300	6,500
Regent Drlg Co Ltd	1	dsl	260	Brwstr N-4	260	6,000
	26	dsl	260	Ideco H-40	260	7,500
	29	dsl	260	Brwstr N-4	260	6,000
	21	dsl	260	Brwstr N-4	260	9,000/3½" 6,000/4½"
Pendryl						
Cactus Drlg Corp Ltd	6	dsl	585	Emsco GB-350	585	7,500
Penhold						
Canbridge Corp Ltd	10	dsl	420	Emsco GA-350	420	7,500
Duke Drlg Co Ltd	9	dsl	500	M-CSCO U-15	650	9,000
Pigeon Lake						
S & T Drlg Co Ltd	1	dsl	440	Natl 50-A	440	8,000
Parker Drlg Co of Canada Ltd	11	dsl	400	Natl 50-A	600	6,500
Pincher Creek						
Brinkerhoff Drlg Co Ltd	8	dsl	900	Natl 110	1200	15,000
	19	dsl	850	Emsco A-800	1269	14,000
Cascade Drlg Co Ltd	14	dsl	1350	M-CSCO U-20	1350	14,000
Red Deer						
Chupp Well Serv Ltd	5	—	—	Ideco M-25-D	—	10,000
Rine Drlg Co of Canada Ltd	1	dsl	300	Brwstr N-45	780	7,500
	2	dsl	370	Brwstr N-55	720	8,500
Rimbey						
Big Indian Drlg Co Ltd	10	gas	—	Mayhew	—	2,000/2⅞"
Rocky Mountain House						
Can Tex Drlg & Expl Ltd	5	dsl	900	"Oilwell" 66	900	9,000
Regent Drlg Co Ltd	7	dsl	1200	Natl 125	1500	15,000
Sedalia						
Canbridge Corp Ltd	*1	dsl	380	Crdwll Trailerig	380	6,000
Simonette						
Pennant Drlg Serv Ltd	6	dsl	1350	M-CSCO U-40	1200	11,500
Peter Bawden Drlg Ltd	15	dsl	834	M-CSCO U-40	834	11,500
Regent Drlg Co Ltd	9	dsl	750	Brwstr N-75	780	10,000
Skaro						
Peter Bawden Drlg Ltd	3	dsl	194	Crdwll S	194	4,500
Smith						
Canbridge Corp Ltd	*9	dsl	300	Crdwll L	200	5,000
Stettler						
Canbridge Corp Ltd	7	dsl	780	Crdwll O	780	9,000
Parker Drlg Co of Canada Ltd	6	dsl	420	Natl 50	420	6,500
Sundre						
Can Tex Drlg & Expl Ltd	6	dsl	800	Emsco 500	800	9,000
Lohmann-Johnson Drlg Co Ltd	2	dsl	500&265	M-CSCO U-15	500	9,000
Swan Hills						
Peter Bawden Drlg Ltd	6	dsl	720	M-CSCO U-36-A	720	8,500
	7	dsl	832	Natl 55	832	9,500
	9	dsl	1000	M-CSCO U-40	1000	11,500
	20	dsl	834	"Oilwell" 76	834	11,500
	25	dsl	556	"Oilwell" 66	556	8,000
Brinkerhoff Drlg Co Ltd	15	dsl	500	Natl 50-A	600	8,500
Can Tex Drlg & Expl Ltd	3	dsl	1000	Emsco 800	1000	13,000
	7	dsl	800	Emsco 500	800	9,000
Canbridge Corp Ltd	12	dsl	670	Emsco GB-500	670	9,000
Cascade Drlg Co Ltd	17	dsl	1190	Natl 75	1190	12,000
	20	dsl	825	JB-750	825	11,000
	21E	dsl-elec	825	—	1100	11,000
Commonwealth Drlg Co Ltd	21	dsl	1250	Ideco 7-11	900	10,500
	23	dsl	905	Emsco GC-500	800	9,500
Hi-Tower Drlg Co Ltd	1	dsl	525	"Oilwell" 66	800	8,000
	4	dsl	350	Natl 50-A	450	8,500
	6	dsl	755	"Oilwell" 76	900	12,000
	7	dsl	525	"Oilwell" 66	800	8,000
Hunter Drlg Ltd	2	dsl	900	Crdwll J-700	1150	12,000
Parker Drlg Co of Canada Ltd	2	dsl	800	"Oilwell" 76	1275	11,500
	12	dsl	650	"Oilwell" 66	800	9,000
Reading & Bates Drlg Co Ltd	1	dsl	1000	NSCO 75	1000	10,000
	3	dsl	1000	NSCO 75	1000	12,000
Regent Drlg Co Ltd	2	dsl	520	Brwstr N-55	520	8,500
	3	dsl	720	Brwstr N-7	520	9,000
	25	dsl	750	Brwstr N-75	780	10,000
Swipe Lake						
Regent Drlg Co Ltd	8	dsl	750	Brwstr N-75	780	10,000
Three Hills						
S & T Drlg Co Ltd	2	dsl	220&180	Natl T-32	250	6,000
Turin						
Coultis Drlg Ltd	1	dsl	248	Ideco H-25-D	248	3,500
Veteran						
Big Horn Drlg Ltd	2	dsl	250	Crdwll L	180	3,500
Virginia Hills						
Brinkerhoff Drlg Co Ltd	1	dsl	625	Emsco GC-500	846	10,000
Commonwealth Drlg Co Ltd	16	dsl	800	Emsco GB-350	720	7,000
Lohmann-Johnson Drlg Co Ltd	1	dsl	500&600	"Oilwell" 66	600	9,000
Parker Drlg Co of Canada Ltd	3	dsl	765	"Oilwell" 76	1005	12,000
Pennant Drlg Service Ltd	2	dsl	1155	Brwstr N-7	755	8,500
Waterton						
Commonwealth Drlg Co Ltd	1	dsl	1350	Natl 110	1500	14,000
Jennings Drlg Co (Alberta) Ltd	4	dsl	300	Beth 55 Twstr	300	6,000
Wayne						
Cactus Drlg Corp Ltd	3	dsl	420	Natl T-32	280	6,000
Precision Drlg Co Ltd	12	dsl	278	Brwstr N-4	350	5,500
Westward Ho						
Cactus Drlg Ltd (Canada)	2	dsl	850	Natl 55	850	9,500
Whitecourt						
Petrolia Drlg Ltd	11	dsl	950	M-CSCO U-40	1050	12,000
Wildcat Hills						
Duke Drlg Co Ltd	7	dsl	850	M-CSCO U-20	1386	15,000
Willesden Green						
Commonwealth Drlg Co Ltd	13	dsl	630	Emsco GA-350	720	6,500
Gustavson Drlg Co Ltd	2	dsl	500	Natl T-32	250	6,500
Hi-Tower Drlg Co Ltd	12	dsl	375	Crdwll 201	300	6,000
	15	dsl	400	Crdwll 201	300	6,000
Worsley						
Regent Drlg Co Ltd	5	dsl	720	Brwstr N-7	520	8,000
BRITISH COLUMBIA						
Undesignated						
Canamercian Drlg Corp Ltd	*1	dsl	500	Natl T-32	335	6,500
Alaska Highway						
Parker Drlg Co of Canada Ltd	8	dsl	500	Natl 50	700	7,500
Trinity Canadian Drlg Co	5	dsl	1250	Emsco A-800	1150	15,000
	7	dsl	875	Emsco GC-500	720	10,000
Beaver River						
Cascade Drlg Co Ltd	2	dsl	1190	Natl 100	1190	12,000
Boundry Lake						
Peter Bawden Drlg Ltd	1	dsl	415	Natl T-32	305	5,500
Hi-Tower Drlg Co Ltd	14	dsl	350	Crdwll 200	300	6,000
Tri-City Drlg Co Ltd	2	dsl	375	Unit U-34	275	5,500
Cypress Creek						
Parker Drlg Co of Canada Ltd	4	dsl	800	"Oilwell" 76	1100	12,500
Fort Nelson						
Peter Bawden Drlg Ltd	19	dsl	556	Emsco GB-500	556	8,500
Brinkerhoff Drlg Co Ltd	14	dsl	370	Emsco GB-500	600	8,500
	20	dsl	370	Natl 50-A	450	8,500
Cascade Drlg Co Ltd	4	dsl	550	Natl 50-A	550	7,500
	11	dsl	550	Natl 50	550	6,500
	18	dsl	825	Natl 100	825	12,000
Commonwealth Drlg Co Ltd	20	dsl	1270	Ideco 7-11	900	10,500
Reading & Bates Drlg Co Ltd	4	dsl	1200	NSCO 80-B	12,000	14,000
	5	dsl	750	NSCO 50-A	750	9,000
Ft. St. John						
Brinkerhoff Drlg Co Ltd	23	dsl	250	Natl T-20	300	5,000
Canbridge Corp Ltd	*8	dsl	380	Crdwll Trailerig	380	6,000
Hi-Tower Drlg Co Ltd	5	dsl	350	Natl 50	450	5,000
	11	dsl	350	Crdwll 200	300	6,000
Trinity Canadian Drlg Co	1	dsl	995	Emsco GC-500	770	10,000
Jedney						
Peter Bawden Drlg Ltd	24	dsl	556	M-CSCO U-15	556	7,500
Canbridge Corp Ltd	13	dsl	670	Emsco GA-500	670	9,000
	14	dsl	420	Emsco GB-350	420	7,500
Commonwealth Drlg Co Ltd	22	dsl	750	Natl 50	530	6,500
	24	dsl	520	Natl 50	600	6,000
Pouce Coupe						
Gustavson Drlg Co Ltd	5	dsl	420	Natl T-45	420	7,500
Queen Charlotte						
Commonwealth Drlg Co Ltd	15	dsl	800	Brwstr N-7	600	8,000
MANITOBA						
Virden						
Coultis Drlg Ltd	2	dsl	250	Wisn Torcair	250	4,000
	3	dsl	248	Wgnr Mrhse TD-2	150	3,000
Whitewater						
Commonwealth Drlg Co Ltd	18	dsl	260	Ideco H-25-D	300	4,500
NORTHWEST TERRITORY						
Calibeta						
Brinkerhoff Drlg Co Ltd	26	dsl	600	Emsco GB-350	425	7,000
Fort Good Hope						
Big Indian Drlg Co Ltd	5	gas	—	Mayhew	—	2,000/2⅞"
Grande View Hills						
Peter Bawden Drlg Ltd	16	dsl	556	"Oilwell" 64-B	556	7,500
Hay River						
Tri-City Drlg Co Ltd	3	dsl	190	Failing 2500	190	2,500
Liard						
Peter Bawden Drlg Ltd	8	dsl	560	Natl 50-A	560	8,500
Matson Creek						
Cascade Drlg Co Ltd	19	dsl	840	Natl 100	840	12,000
Melville Island						
Peter Bawden Drlg Ltd	22	dsl	834	"Oilwell" 76	834	11,500

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
Wrigley						
Big Indian Drlg Co Ltd	9	gas	—	Mayhew	—	1,500/2⅞"
QUEBEC						
Trois Rivers						
Big Indian Drlg Co Ltd	14	gas	—	Failing	—	2,000/2⅞"
SASKATCHEWAN						
Undesignated						
Canamerican Drlg Corp Ltd	*4	dsl	600	Natl T-20	275	5,000
	*5	dsl	500	Natl T-32	335	6,500
	*6	dsl	600	Natl T-12	275	4,000
	*7	dsl	600	Natl T-20	275	5,000
Charter Drlg Co Ltd	1	dsl	—	U-34	—	5,500
	2	dsl	—	Emsco 250	—	6,000
L & J Drlg Ltd	5	dsl	440	Crdwll "S"	300	4,500
Porter Drlg Ltd	*1	dsl	500	Natl T-32	360	6,000
	*2	dsl	720	Natl 50	720	8,000
Carnduff						
Commonwealth Drlg Co Ltd	5	dsl	260	Emsco GA-250-T	310	5,000
Carlevale						
Commonwealth Drlg Co Ltd	2	dsl	490	Natl 50	530	6,000
East End						
Precision Drlg Co Ltd	9	dsl	278	Brwstr N-4	350	5,500
Estevan						
Regent Drlg Co Ltd	22	dsl	260	Brwstr N-4	260	6,000
Frontier						
Hi-Tower Drlg Co Ltd	16	dsl	400	Crdwll 201	300	6,000
Kindersley						
Precision Drlg Co Ltd	8	dsl	278	Ideco H-30-D	350	5,500
Midale						
Regent Drlg Co Ltd	23	dsl	260	Brwstr N-4	260	6,000
	27	dsl	260	Brwstr N-4	260	6,000
Parkman						
Hunter Drlg Ltd	1	dsl	450	Crdwll	260	6,000
Regina						
Big Indian Drlg Co Ltd	1	gas	—	Mayhew	—	2,000/2⅞"
Stoughton						
Commonwealth Drlg Co Ltd	4	dsl	260	Ideco H-40-D	300	6,000
Swift Current						
Precision Drlg Co Ltd	15	dsl	550	M-CSCO U-34	350	6,000
Weyburn Field						
Central-Del Rio Oils Limited Drlg Div	1	dsl	500	Natl 50	500	6,500
	2	dsl	285	Crdwll TR-66	245	5,000
Commonwealth Drlg Co Ltd	12	dsl	260	Natl T-32	300	5,500
YUKON						
Parker Drlg Co of Canada Ltd	1	dsl	800	"Oilwell" 76	1275	11,500

International Contractors

An-Son Drlg Co of Colombia
Big Chief Drlg Co Box 8837 Oklahoma City 14 Okla
Carmack Drlg Co 1008 Mile High Ctr Denver 2 Colo
Delta Drlg Co Box 2012 Tyler Tex
Delta Drlg Co (Rome Italy) Box 2012 Tyler Tex
Delta Overseas Drlg Co (Rome Italy) Box 2012 Tyler Tex
Societe Forex P O Box 28 PAU Basses Pyrenees France
Societe Languedocienne de Forages Petroliers 15 Rue Des Sablons Paris 16 France
Helmerich & Payne Inc 6th floor 1st Natl Bank Bldg Tulsa Okla
International Drlg Co Bezuidenhoutsewag 50 Hague Holland
Kerr-McGee Oil Industries Kerr-McGee Bldg Okla City Okla
Perforaciones Laughlin-Porter Bernado de Irrigoyen 972 Piso 9 Buenos Aires Argentina
Perforaciones Delta C A Apartado 9138 Maracaibo Venezuela
Perforadora Central SA de C V Ramon Guzman 114 Mexico 4 DF
Perforadora Latina SA Madrid #21 Mexico 4 DF
Southeastern Drlg Corp Rm 1101 211 N Ervay Bldg Dallas Tex
Walters Drlg Co Inc 4114 McMillan St Dallas 6 Tex

International Rig Section

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
ALGERIA-SAHARA						
Societe FOREX	F-2500/2	dsl	200	Failing	160	—
	F-2500/3	dsl	200	Failing	160	—
	S 7/11-4	dsl	2250	Ideco	1200	15,000
	S 7/11-5	dsl	2250	Ideco	1200	15,000
	H 525/2	dsl	750	Ideco	500	7,500
	H 525/3	dsl	750	Ideco	500	7,500
	GB 250/1	dsl	625	Emsco	250	6,000
	GB 250/2	dsl	625	Emsco	250	6,000
	GB 250/3	dsl	625	Emsco	250	6,000
	H 30/1	dsl	750	Ideco	250	4,500
	H 30/2	dsl	750	Ideco	250	4,500
	160	dsl	375	Emsco	160	4,000
	F-2500/1	dsl	200	Failing	160	—
	H 7/11	dsl	1200	Ideco	800	10,000
	S-7/11-3	dsl	1500	Ideco	1200	15,000
	PR-1050	dsl	1500	Ideco	1000	15,000
	—	dsl	2250	Emsco A-1500	1800	17,000
	—	dsl	—	Wgnr Morehouse	200	—
Societe Languedocienne de Forages Petroliers	1	dsl	1000	Ideco H-525	520	8,500
	2	dsl	1300	Emsco 800	1660	13,000
	3	dsl	1000	Emsco 800	1660	13,000
	4	dsl	1300	Ideco 7-11	1660	13,000
	5	dsl	1000	Emsco 800	1900	13,000
	6	dsl	1000	Natl 80-B	1900	13,000
	6	dsl	1300	Ideco 7-11	1660	13,000
	8	dsl	1200	Ideco 7-11	1900	13,000
	8	dsl	1000	Natl 110	1900	15,000
	9	dsl	1200	Natl 110	1760	15,000
	10	dsl	1000	Natl 50	1200	8,000
ARGENTINA						
Kerr-McGee Oil Ind Inc	*CU 1	dsl	110	Wgnr Mrhse E-15-38B	280	3,000
	*CU 2	dsl	110	Wgnr-Mrhse E-15-38B	280	3,000
	*CU 3	dsl	110	Wgnr-Mrhse E-15-38B	280	3,000
	*CU 4	dsl	110	Wgnr-Mrhse E-15-38B	280	3,000
	3	dsl	970	Natl 75	1000	11,500
	28	dsl	970	Natl 75	1000	11,500
	41	dsl	970	Natl 75	1000	11,500
	42	dsl	970	Natl 75	1000	11,500
	52	dsl	500	Emsco GC-350T	840	6,000
	53	dsl	500	Emsco GC-350T	840	6,600
Perforaciones Laughlin-Porter S A (PERLAP)	2	gas	1050	U-15	750	7,500
	5	dsl	1560	Natl 100	1000	12,000
	8	gas	1580	Natl 75	1210	11,000
	*9	dsl	1150	Ideco H-30D	300	6,000
Southeastern Drlg Co	70	dsl	600	Uldeco H-525	1040	8,500
	71	dsl	600	Ideco H-525	1040	8,500
	72	dsl	600	Ideco H-525	1040	8,500
	73	dsl	600	Ideco H-525	1040	8,500
	74	dsl	600	Ideco H-525	1040	8,500
	75	dsl	600	Ideco H-30	357	8,500
AUSTRALIA						
Delta Drlg Co	41	dsl	1300	Natl 130	1400	16,000
BOLIVIA						
Big Chief Drlg Co	29	dsl	1875	Emsco 1250	1815	16,000
	31	gas	1545	Emsco 800	1515	13,500
	37	gas	1875	Emsco 1250	1815	16,000
Kerr-McGee Oil Ind Inc	51	dsl	970	Natl 75	1000	11,500
BRAZIL						
Brantly Drlg Co (Intl) Inc	1	dsl	850	"Oilwell" 52-T	500	7,000
	2	dsl	950	Ideco H-40	600	7,500
Parker Drlg Co	5	gas	—	Natl 50	700	9,000

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
BRITISH HONDURAS						
Carmack Drlg Co	5	dsl	400	Natl D-300	300	5,000
Kerr-McGee Oil Ind Inc	14	dsl	695	Natl 50	630	9,000
	50	dsl	1000	Natl 55	750	10,000
COLOMBIA						
An-Son Drlg Co of Colombia	2	dsl	1200	Crdwll "O"	1000	10,000
	*3	dsl	1000	Crdwll J-450	600	7,500
	4	dsl	1500	Natl 80-B	1000	12,000
	*5	dsl	1000	Ideco H-40	700	6,000
	*6	dsl	300	Frnks	300	3,500
	*8	dsl	300	Ideco H-25	300	3,500
	*9	dsl	350	Ideco H-30	350	3,500
Llano Drlg Co	8	dsl	800	Ideco H-30	300	5,500
	*8	dsl	800	Ideco H-30	300	5,500
COTE D'IVOIRE						
Societe Languedocienne de Forages Petroliers	6	dsl	1200	Emsco 800	1900	13,000
FRANCE						
Societe FOREX	—	dsl	375	Haniel & Lueg	125	2,500
	S-7/11-1	dsl	1600	Ideco	1200	15,000
	55/1	dsl	1250	Natl	700	9,000
	55/2	dsl	1000	Natl	700	9,000
	H-525/1	dsl	750	Ideco	500	7,500
	H-40/3	dsl	750	Ideco	250	6,000
	H-30/3	dsl	80	Ideco	250	—
	H-25	dsl	375	Ideco	250	—
	F-2500/4	dsl	300	Failing	160	—
Societe Languedocienne de Forages Petroliers	*—	dsl	350	Massarenti	520	4,000
	2	dsl	1000	Natl 100	840	11,000
	2	dsl	1200	Ideco 7-11	1900	13,000
	3	dsl	1130	Natl 50	520	8,000
	4	dsl	600	Emsco 250	750	7,000
	4	dsl	950	Natl 50	520	8,000
	5	dsl	1300	Ideco 1350S	1900	15,000
	7	dsl	1300	Ideco 7-11	1660	13,000
	Sog	dsl	1200	Ideco 7-11	1425	13,000
	*S-206	dsl	110	Crdwll	140	10,000
GABON						
Societe FOREX	H 40/2	dsl	750	Ideco	250	6,000
HOLLAND						
International Drlg Co	1	dsl	900	Natl 55	900	9,000
IRAN						
International Drlg Co	6	dsl	2100	Natl 110	1500	16,000
Southeastern Drlg Co	50	dsl	1600	OW-96	1600	16,000
	51	dsl	1600	OW-96	1600	16,000
	58	dsl	1600	OW-96	1600	17,000
	59	dsl	1600	OW-96	1600	17,000
ITALY						
Delta Overseas Drlg Co	1	dsl	900	Emsco 500	600	7,000
	2	dsl	260	Ideco H-30	300	4,500
	3	dsl	500	Emsco GB-500	500	8,500
	4	dsl	900	Emsco 800	900	11,000
KUWAIT						
International Drlg Co	4	dsl	1620	Natl 80-B	1400	12,000
	11	dsl	1700	Natl 110	1200	16,000
LIBYA						
International Drlg Co	3	dsl	870	Natl T-32	500	5,500
	5	dsl	1620	Natl 80-B	1400	12,000
	9	dsl	740	Natl T-32	500	5,500
	12	dsl	900	Natl 55	900	9,000
	15	dsl	1000	Natl T-45	800	7,500
	16	dsl	1400	Emsco A-800	1400	12,000
	18	dsl	900	Natl 55	900	9,000
MADAGASCAR						
Societe Languedocienne de Forages Petroliers	7	dsl	750	Natl 100	1600	11,000
MEXICO						
Perforadora Central S A de C V	1	dsl	750	Emsco GC-500	500	10,000
	2	dsl	750	Natl Ideal 55	500	10,000
	3	dsl	750	Emsco G-500	500	10,000
	4	dsl	750	Emsco GC-500	600	10,000
Perforadora Latina, S A	6	dsl	975	Emsco G-500	500	7,500
	7	dsl	775	M-CSCO	350	5,000
	8	dsl	975	Emsco GB-500	500	7,500
	9	dsl	975	Emsco GB-500	500	7,500
	10	dsl-elec	975	Natl 34-10	1000	12,000
	11	dsl-elec	975	Natl 23-10	1000	12,000
	12	dsl	1250	Emsco 750	1250	12,000
	13	gas	1200	Natl 80-B	1000	12,000
	14	gas	1050	Natl 100	950	12,000
Walters Drlg Co Inc (Dallas)	9	gaso	130	Mayhew 1000	130	800/2⅞"
	11	gas	150	Mayhew 1000	150	600/2⅞"
MOROCCO						
Societe FOREX	S-7/11-2	dsl	1100	Ideco	1200	15,000

Contractor's Name	Rig No.	Type Power	Total HP All Main Mud Pumps	Drawworks Make and Model	Total HP Available to Drwwks	Rated Depth with 4½" Pipe
NIGERIA						
International Drlg Co	8	dsl	2100	Natl 110	1500	16,000
PERSIAN GULF						
Southeastern Drlg Co	12	dsl	2200	OW-96	1100	16,000
	54	dsl	2200	OW-96	1600	16,000
	55	dsl	1600	OW-96	1000	16,000
	57	dsl	2200	OW-96	1600	16,000
SENEGAL						
Societe FOREX	Natl 100	dsl	1300	Natl 100	800	11,500
SOMALIA						
International Drlg Co	2	dsl	2100	Natl 110	1200	16,000
SPAIN						
Societe Languedocienne de Forages Petroliers	1	dsl	1300	Natl 100	840	11,000
TRINIDAD						
Santa Fe Drlg Co	34	gas	1050	Natl 80-B	900	10,000
TUNISIA						
Societe Languedocienne de Forages Petroliers	3	dsl	1200	Ideco 7-11	1900	13,000
VENEZUELA						
Helmerich & Payne Inc	61	dsl	—	Natl 125	—	—
	62	dsl	—	Natl 125	—	—
	63	stm	—	Natl 34-10	—	—
	64	stm	—	Natl 34-10	—	—
	65	dsl	—	Natl 50-A	—	—
	66	dsl	—	Natl 125	—	—
	67	dsl	—	Natl 110	—	—
	68	stm	—	Natl 34-10	—	—
Kerr-McGee Oil Ind Inc	V-1	dsl-elec	2000	Emsco A-800-E	1500	13,000
	V-2	dsl-elec	2000	Emsco A-1100-E	1500	16,000
Perforaciones Delta C A (Maracaibo Venezuela)	1	dsl	260	Ideco H-40-D	400	6,500
	2	dsl	260	Ideco H-40-D	400	6,500
	4	dsl	260	Ideco H-40-D	400	6,500
	7	dsl	260	Ideco H-30-D	300	4,500
	9	dsl	1000	Emsco GB-800	900	12,000
	10	dsl	260	Crdwll O	450	7,500
	11	dsl	130	Natl T-12	120	2,500
	Bge 12	dsl	1560	Emsco J-1250	1250	15,000
	Bge 13	dsl	1040	Emsco J-1250	1250	15,000
	Bge 14	dsl-elec	2000	Emsco ECB	1200	15,000
	Bge 16	dsl-elec	2000	Emsco ECB	1200	15,000
	17	dsl	200	Crdwll R	250	4,500
	18	dsl	200	Crdwll R	250	4,500
	19	dsl	260	Crdwll TR	250	6,000
	20	dsl	260	Crdwll TR	250	6,000
	21	dsl	260	Crdwll TR	250	6,000
	23	dsl	520	Natl 100	900	12,000
Santa Fe Drlg Co	23	dsl	300	Ideco H-40	300	6,000

Offshore Rig Locator

DRILLING CONTRACTORS

An-Son Offshore Drlg Co 1221 Carondelet Bldg New Orleans 12 La
Blue Water Drilling Corp 1001 Carondelet Bldg New Orleans La
Caldrill Offshore Inc 3400 Loma Vista Rd Ventura Calif
Circle Drlg Co 620 Pioneer Bldg Lake Charles La
Continental Drlg Corp 1010 Commerce Bldg New Orleans La
Delta Marine Drlg Co Box 2012 Tyler Tex
Dixilyn Corp Box 3427 Odessa Tex
Global Marine Expl Co 650 S Grand Ave Los Angeles 17 Calif
Kerr-McGee Oil Industries Inc Kerr-McGee Bldg Oklahoma City Okla
Louisiana-Delta Offshore Corp 211 Maritime Bldg New Orleans 12 La
Movible Offshore Co 743 San Jacinto Bldg Houston 2 Tex
Ocean Drlg & Production 300 Caribe Bldg New Orleans La
Penrod Drlg Co 1320 Mercantile Security Bldg Dallas Tex
Reading & Bates Offshore Drlg Co 728 T N B Bldg Houston 2 Tex
Rimrock-Tidelands Inc P O Box 896 New Orleans La
Sea Drlg Corp 809 Whitney Bldg New Orleans La
The Southeastern Drlg Corp 901 Employers Insurance Bldg Dallas 2 Tex
Submarex Corp 34 E Mason St Santa Barbara Calif
Tideland Drlg Co 215 Shell Bldg New Orleans La
Zapata Off-Shore Co 1701 Houston Club Bldg Houston Tex

CALIFORNIA

Contractor's Name	Rig, barge Name or No.	Type rig Power	Total HP all main mud pumps	Drwwks Make & Model	Total HP available to Drwwks	Rated depth with 4½" pipe	Max. water depth capacity	Location
Caldrill Inc (Offshore)	D	dsl	1700	OWS 96	1200	16,000	—	Santa Barbara
	E	dsl elec	1200	OWS 860E	1000	14,000	—	Santa Barbara
Global Marine Expl Co	Sm-1 Floating Barge	dsl eng	420	Hopper GTA	420	6,000	—	Santa Barbara
	Cuss 1 Floating Barge	dsl eng	1750	Natl 80B	1750	12,000	—	Santa Barbara
Submarex Corp	Vsl Exploit	dsl	225	Special	150	3,000	—	San Pedro Harbor

GULF OF MEXICO

Dixilyn Corp	Rig No 8 "Julie Ann" Mobile Drling	dsl	2490	Natl 1625 DE	2490	25,000	105	Block 205, Eugene Island area
Tidelands Drlg Co	Mr Gus #2 Mobile Drlg Barges	dsl elec	3600	Natl 160E	1800	20,000	150	West Delta Blk 71

LAKE SUPERIOR

Global Marine Expl Co	Submarex Floating Vessel	dsl eng	600	Howard Turner	1800	18,000	—	Lake Superior

LOUISIANA

An-Son Offshore Drlg Co	Brg #2	dsl	2200	Natl 125	1800	20,000	12	Plaquemines
Blue Water Drlg Corp	"Blue Water #1" Mobile Drlg Barges	dsl elec	2700	Emsco EDES	2600	20,000	67	Blk 139 Ship Shoal area
Circle Drlg Co Inc	Bge 6	dsl elec	2300	Ideco E2500	2750	20,000	18	Lafourche
Continental Drlg Co	#8	dsl	2100	1013 Beth	2100	20,000	16	Morgan City
Delta Marine Drlg Co	Tender "Joseph Zeppa"	dsl elec	1600	Emsco JB-1250	1600	15,000	—	Grand Isle
	Bge "Chris Zeppa"	dsl elec	2000	Ideco Big Gnt	1200	15,000	34	Vermilion
Kerr-McGee Oil Industries Inc	40	dsl	2000	Emsco J-1600	m 2080	15,000	18	Blk 28 Field Ship Shoal
	44	dsl	2000	Ideco 1350-S	1700	18,000	40	Morgan City
	45	dsl	1500	Natl 125	1560	15,000	35	Blk 84 West Delta
	46	dsl elec	2000	Emsco EDA	1250	20,000	70	Blk 128 Vermilion Area
	47	dsl elec	2000	Emsco	1250	20,000	70	Blk 21 S Timbalier Area
	48	dsl elec	2000	Emsco EDA	1250	20,000	Tender unit	Blk 130 S. Timbalier Blk 131 Field
	49	dsl elec	—	Emsco EDA	1250	20,000	Tender unit	Blk 214 Ship Shoal
Louisiana-Delta Offshore Corp	1	dsl	800	M-CSCO U-20	1000	14,000	±8 to 9	WOL Empire
	2	dsl elec	1400	M-CSCO U-1220	1200	20,000	—	OCS-0796 Blk 100 Eugene Is.
	3	dsl elec	2000	M-CSCO U-1220	1200	20,000	—	S/C 1027 #2 Blk 34 So Timbalier
Movible Offshore Co	Movible #2 Mobile Drlg Barges	dsl elec	2000	Natl 1625	2500	25,000	70	South Pass Area
	Movible #3 Mobile Drlg Barges	dsl elec	1700	Emsco EDA	1600	20,000	40	South Pass Area
	Movible #4 Tender	dsl elec	1450	M-CSCO U-914	1400	16,000	200	Vermilion Area
Ocean Drlg & Expl Co	Mr Charlie Submersible	dsl elec	—	Emsco	—	15,000	40	Blk 20 S Pelto Area
	El Dorado	dsl elec	—	Emsco EDES	—	15,000	70	Blk 120 Ship Shoal Area
	Margaret Mobile	dsl elec	—	Emsco EDES	—	15,000	65	Blk 27 S. Pass Area
	St Louis Submersible	dsl elec	—	Emsco ECA	—	15,000	30	Blk 100 Eugene Is.
	John Hayward Submersible	dsl elec	—	Emsco ECA	—	15,000	30	Blk 16 Vermilion Area
Penrod Drlg Co	51	dsl	2000	Emsco EDES	1800	20,000	60	Lafourche Parish
	50	dsl	3000	Emsco EDES	1800	20,000	60	South Louisiana
	52	dsl	2000	Emsco EDES	1800	20,000	100	Eugene Island
Reading & Bates Expl Co	"G L Temple" Tender	dsl	1800	"Oilwell" 96	1800	18,000	—	W Cameron Area Blk 180B
Reading & Bates Offshore Drlg Co	Geo M Reading Tender	dsl eng	2000	Natl 130	2000	18,000	—	South Marsh Island Blk 23
	J W Nickle	dsl elec	2000	Beth B-3661	2000	19,000	—	W Cameron Area
Rimrock-Tidelands Inc	"Rimtide" Mobile Drlg Barges	dsl	2000	Emsco A-1500	1500	20,000	36	State Lease PP 192 LaFourche Parish
	Union Prod Co Drill Barge A Mobile	dsl elec	1250	Ideco E-2500	1600	25,000	70	Federal Offshore Waters Blk 173 W Cameron Parish
Sea Drlg Corp	#2	dsl elec	1800	Natl	1800	18,000	30	Blk 105 Eugene Island Area
	#3	dsl elec	1800	Emsco	1800	18,000	30	Blk 41 S Pass Area
Southeastern Drlg Co	Mobile Platform #22	—	1600	"Oilwell" 96	2200	16,000	—	Ship Shoal Area

MEXICO

Contractor's Name	Rig, barge Name or No.	Type rig Power	Total HP all main mud pumps	Drwwks Make & Model	Total HP available to Drwwks	Rated depth with 4½" pipe	Max. water depth capacity	Location
Reading & Bates Expl Co	"Mr Louie" Mobile Drlg Barges	dsl elec	2000	M-CSCO U-1220	2000	20,000	110	Offshore Bay of Campeche

PERSIAN GULF

Reading & Bates Offshore Drlg Co	O E Thornton Mobile	dsl eng	2000	Natl 130	1800	16,000	125	Persian Gulf
	J W Bates Tender	dsl eng	2000	Natl 130	2000	18,000	—	Persian Gulf

TEXAS

Zapata Off-shore Co	Vinegaroon	—	2400	"Oilwell" 96	—	15,000	110	Galveston
	Scorpion Mobile	—	2400	"Oilwell" 96	—	15,000	85	Galveston
	Nola III	—	2000	Emsco J 1250	—	15,000	undetermined	Brazos
	Nola I Overside	—	1500	Natl 130	—	15,000	undetermined	Veracruze

U. S. Cable Tool Drilling Contractors

A

Allen Drlg Co 4410 Venable Ave Charleston 4 W Va
Angelus Drlg Co Box 1029 San Angelo Tex
Arrowood Roy Box 338 Cross Plains 2 Tex

B

Baggett Drlg Co 4305 Univ Dr Wichita Falls Tex
Bar-Lee Drlg Co Box 7264 Tulsa Okla
Beck K L 3826 Randolph Blvd San Antonio Tex
Berentz Drlg Co Box 22 Eureka Kans
Bernhardt Drlg Co 2469 Grand River Detroit 1 Mich
Berry Thos N & Co Box 111 Stillwater Okla
Boyd Tom Drlg Co 102 S 2nd St Artesia N M

C

Canton Oil & Gas Co 626 Renkert Bldg 306 N Market Ave Canton 2 Ohio
Carper Drlg Co Inc Box 905 Hobbs N Mex
Crouch Louis Box 687 Lockhart Tex
Cummins Drlg Co Altamont Ill

D

Dillier W L Box 205 Casey Ill

E

Eatmon Drlg Co Box 535 Kimball Neb
Ellis Drlg Corp Box 393 Colorado City Tex
Ensminger Drlg Co Box 45 Chanute Kans

F

Fairman Drlg Co Hammersley Fork Pa
4-J Drlg & Well Serv Co Box 471 Drumright Okla

G

Gladson Willard & Odstrcil Bros Drlg Co 2705 W 35th St Snyder Tex

H

Hatcher H F & Son Drlg Co Box 447 Smackover Ark
Henderson Ed F Box 531 Monahans Tex
Hipp Chas E Box 26 Graham Tex
R L Horn & Sons Drlg Co Pawnee Okla

J

Charles M Jameson 29 S State St Salt Lake City Utah
Jetmar Well Serv Box 736 Great Bend Kans
Johnson F M Well Serv Box 613 Olney Tex
Jones Bros Oil Co Sedan Kans

K

Kirby Oil Ind Inc 5107 Center St Omaha 6 Neb
Krumme Oil Co Box 749 Bristow Okla

L

Ladd Ralph G Box 5 Haskell Okla
Lawrence J W Box 942 Conrad Mont
Lindsay Drlg Co 1305 S Highland Chanute Kans

M

M-H-O Drlg Co Box 297 Cut Bank Montana
Morgan Dave Drlg Co Box 820 Blackwell Okla

N

Northern Drlg Co Kevin Mont

O

Oilwell Serv Co Box 2185 Cut Bank Mont
Oney Drlg Co Box 425 Graham Tex

P

Payne Bros Drlg Co 611½ 12th Street Box 15 Lawrenceville Ill
Pool Fred Drlg Co 3106 Lockheed Midland Tex
Prairie Drlg Co Box 2068 Casper Wyo
Prairie Oilfield Serv Inc P O Box 97 Great Bend Kansas

R

Robinson Mrs Arthur D Kirby Bldg Dallas Tex
Robinson Bros Oil Producers Box 430 Borger Tex
Russell & Russell Drlg Co 621 Lindsay St Gainesville Tex

S

Seiboldt Drlg Co 106½ N Harrison Cushing Okla
SeRoBee Drlg Co Inc 412 Union Natl Bk Bldg Wichita Kans
Shields Oil Producers Inc Box 709 Shields Bldg Russell Kans
Shulman Bros Box 191 Vandalia Ill
Slape Don Drlg Co Box 432 Olney Ill
Smallwood Drlg Co Box 9365 Dallas Tex
James Smith Drlg Contr Box 424 Mertzon Tex
Smith Ray Drlg Co 305 Simons Bldg Dallas Tex
Story Jack L Box 1073 Dallas Tex
Stretman C W Drlg Co 620 S 30th St Mattoon Ill
Swindler H L Box 1247 Muskogee Okla

T

Temple Drlg Co Inc 320 Indiana Bk Bldg Evansville Ind
TOCK Drlg Co 617 Union National Bldg Wichita Kans
Tolson Drlg Co 213 Triangle Bldg Pawhuska Okla
Troup & Suttles Inc Box 551 Holdenville Okla

V

Virginia Drlg Co Inc 712 Brown Bldg Wichita 2 Kans
Wagner J H Drlg Co Box 751 Eldorado Kans
West Art Drlg Co 205 O'Michael Bldg Odessa Tex
Wright Drlg Co Box 348 Great Bend Kans

Y

Young W J 1511 Thompson Bldg Tulsa Okla

U. S. Contract CABLE TOOL Drilling Rigs

Contractor's Name	Rig No.	Type Power	HP Driving Engine	Rated Drlg. Depth-Ft.	Rig Make & Model
ARKANSAS					
Union County					
H F Hatcher & Son	1	gas-gaso	150	5000	Crdwll K
	2	gas-gaso	170	7500	Crdwll RL
ILLINOIS					
Clark County					
W L Dillier Inc	1	gas	65	1500	B-Erie 60-L
Clay County					
Shulman Bros	2	gas-gaso	—	4000	Crdwll H
Douglas County					
C W Strotman Drlg Co	1	gas	145	3600	Crdwll H
Fayette County					
Cummins Drlg Co	C-1	gas-gaso	65	1500	B Erie 28-L
	C-2	gas-gaso	65	1500	B Erie 24-L
	C-3	gas-gaso	65	1500	B Erie 60-L
	C-4	gas-gaso	65	1500	B Erie 60-L
	C-5	gas-gaso	78	2500	B Erie 28-L
	C-6	gas-gaso	78	2500	B Erie 28-L
	C-7	gas-gaso	45	1000	B Erie 22-W
Hamilton County					
C W Strotman Drlg Co	4	gas	175	3500	Crdwll K
Lawrence County					
Payne Bros	1	dsl	—	3500	B Erie 36-L
Richland County					
Don Slape Drlg Co	1	btne	—	—	Crdwll K
Shelby County					
C W Strotman Drlg Co	3	gas	145	3600	Crdwll H
Wabash County					
Payne Bros	3	dsl	—	3500	B Erie 36-L
White County					
Shulman Bros	1	gas-gaso	—	4000	Crdwll H
INDIANA					
Gibson County					
Payne Bros	2	dsl	—	3500	B Erie 36-L
C W Strotman Drlg Co	2	gas	175	3500	B Erie 36-L
IOWA					
Dallas County					
Kirby Oil Ind Inc	—	gas-gaso	145	—	Crdwll RL
	—	gas-gaso	145	—	B Erie 28-L
KANSAS					
Allen County					
Ensminger Drlg Co	1	dsl	55	1500	Star Drlg Co
Lindsay Drlg Co	1	dsl	90	3200	Star Spddr 43
	2	dsl	104	3200	Star Spddr 43
Barton County					
Jetmar Well Serv	1	prop	—	7000	Cooper E563
Prairie Oilfield Serv Inc	1	LPG	150	10,000	Crdwll RL
Virginia Drlg Co Inc	1	btne	150	4000	Unit rig
Wright Drlg Co	2	dsl	Buda S44	8000	Crdwll 528
Butler County					
J H Wagner Drlg Co	2	gas-LPG	145	4500	B Erie 36-L
Chase County					
Berentz Drlg Co	1	dsl	225	4100	Natl T-12
Chautaugua County					
Jones Bros Oil Co	—	prop	140	1650	Ft Wrth Spdr Jumbo D
Edwards County					
Peters Drlg Co	673	Waukesha	145	6500	Crdwll RL GMD
Ellis County					
Prairie Oilfield Serv Inc	2	LPG	130	10,000	Crdwll RL
Ellsworth County					
Peters Drlg Co	674	Cummins	200	6500	Crdwll RL GMD
Greenwood County					
Berentz Drlg Co	3	prop	140	3500	Bucyrus 36L
	4	prop	145	3500	Bucyrus 36L
Harvey County					
Wright Drlg Co	4	btne	GK 145	8000	Crdwll 683
Haskell County					
TOCK Drlg Co	3	prop	145	8000	Wlk-Nr C-34
Kingman County					
Wright Drlg Co	3	btne	GK 145	8000	Crdwll 667
Labette County					
Lindsay Drlg Co	3	prop	90	1500	B-Erie 24-L Spddr
McPherson County					
Serobee Drlg Co Inc	1	btne	200	4000	Crdwll L
Marion County					
Berentz Drlg Co	2	dsl	165	3500	Bucyrus 36L
J H Wagner Drlg Co	3	gas-LPG	145	3500	B Erie 36-L
Pratt County					
Wright Drlg Co	1	btne	GK 145	8000	Crdwll 423

Contractor's Name	Rig No.	Type Power	HP Driving Engine	Rated Drlg. Depth-Ft.	Rig Make & Model
Rice County					
Serobee Drlg Co Inc	2	dsl	300	5000	Crdwll RL
Russell County					
Peters Drlg Co	241	Cummins	300	6500	Crdwll KL
Shields Oil Prod Inc	2	dsl	—	8000	Crdwll
	3	dsl	—	8000	B Erie 48-L
Texas County					
TOCK Drlg Co	1	dsl	145	7500	Crdwll RL
	2	dsl	145	7500	Crdwll RL
KENTUCKY					
Henderson County					
Lohmann-Johnson Drlg Co	Spdr 2	btne	—	4500	Crdwll
Union County					
Temple Drlg Co Inc	1	btne	1800	1800	B Erie 24-L
MICHIGAN					
St. Clair County					
Bernhardt Drlg Co	1	btne	—	5000	B Erie 36-L
	2	dsl, gas	—	6000	B Erie 36-L
MONTANA					
Glacier County					
M-H-O Drlg Co	4	gas-btne	165	3500	B Erie 36-L
	6	dsl	140	3000	B Erie 36-L
	7	dsl	220	6000	B Erie 48-L
Oilwell Service	3	gaso	160	4000	Bucyrus 36-L
	4	—	145	4000	Crdwll Model K
Teton County					
J W Lawrence	1	gas-gaso	125	3500	Natl
	2	gas-gaso	175	5000	B Erie
Toole County					
Northern Drlg Co	1	gas-gaso	125	5000	Wichita 66
NEBRASKA					
Cheyenne County					
Eatmon Drlg Co	2	prop	—	8000	Crdwll RL
Kimball County					
Eatmon Drlg Co	1	prop	—	8000	Crdwll RL
	3	prop	—	6000	Wlkr-Nr
NEW MEXICO					
Eddy County					
Tom Boyd Drlg Co Inc	1	btne	145	4500	B Erie 36-L
	2	btne	145	5000	Wich 61
	3	btne	145	5000	Wich 61
Carper Drlg Co Inc	5-C	gas-LPG	125	4000	B Erie 36-L
Fred Pool Drlg Co	—	—	—	4000	Ft Worth Sp F 37
	—	—	—	4500	Ft Worth Sp J 37
Jal County					
Art West Drlg Co	3	gas	145		Crdwll KL
Lea County					
Carper Drlg Co Inc	6-C	gas-LPG	145	6000	Wlkr-Nr S-55
OHIO					
Mahoning County					
Canton Oil & Gas Co	S4	gas-gaso-prop	140	4500	Wlkr-Nr-S33
	S6	gas-gaso-prop	140	4500	B Erie 36-L
Stark County					
Canton Oil & Gas Co	S5	gas-gaso-prop	140	4500	Wlkr-Nr-S33
Trumbull County					
Canton Oil & Gas Co	S7	dsl	175	5500	B Erie 36-L
OKLAHOMA					
Creek County					
4-J Drlg & Well Serv	1	gaso	145	4000	B Erie 36-L
	2	gaso	135	4000	Wlkr Nr 25A
Krumme Oil Co	1	LPG	—	—	B Erie 36-L
	2	LPG	—	—	B Erie 36-L
W J Young	3	LPG	100	4000	Natl 3
Kay County					
Dave Morgan Drlg Co	—	LPG-gas	145	6500	Crdwll RL
Muskogee County					
Ralph G Ladd	1	gas-gaso	65	1750	Star Spddr K
Smallwood Drlg Co	1	gas	—	3600	B Erie 36-L
Swindler Oil Corp	1	gas	150	3500	Wlkr-Nr 33-Spec
	2	gas	150	2000	B Erie 28-L
Okfuskee County					
Troup & Suttles Inc	1	gas-gaso	145	6000	Wlkr-Nr 33
Osage County					
Bar-Lee Drlg Co	1	LPG	120	3000	Wlkr-Nr 532
R L Horn & Sons Drlg & Prod	1	dsl	90	2500	72 Spdstr
Tolson Drlg Co	1	LPG	145	4000	Wlkr-Nr S-33
W J Young	2	LPG	100	4000	Natl 2
Payne County					
Thomas N Berry & Co	2	LPG	145	6000	Wlkr-Nr C-34
	3	LPG	145	6000	Wlkr-Nr C-34
Seiboldt Drlg Co	1	gas	145	8000	Wlkr-Nr C-37

Contractor's Name	Rig No.	Type Power	HP Driving Engine	Rated Drlg. Depth-Ft.	Rig Make & Model
PENNSYLVANIA					
Clearfield County					
Fairman Drlg Co	1	dsl	225	7500	B Erie Spd 48-L
	2	dsl	225	7500	B Erie Spd 48-L
	3	gas	225	7500	B Erie Spd 48-L
	4	gas	225	7500	B Erie Spd 48-L
	5	dsl	170	5000	B Erie Spd 36-L
TEXAS					
Archer County					
Baggett Drlg Co	1	dsl	145	8000	Wlkr-Nr 37
	4	dsl	190	7000	Wlkr-Nr C 27
Baylor County					
Lin-Mour Drlg Co	3	btne	100	5000	Wlkr-Nr C-33
Bexar County					
K L Beck	1	btne-gaso	195	1250	Keystone 50
Callahan County					
Roy Arrowood	2	btne	60	1500	—
Clay County					
Jack L. Story	1	gas	180	5000	Wisn Mogul
Cooke County					
Chas E Hipp Co	15	btne	145	4000	B Erie 36-L
	16	btne	145	4000	B Erie 36-L
Mrs Arthur D Robinson	1	btne	85	2000	Spddr-3 drum
Russell & Russell Drlg Co	1	gas-btne	450	4000	Wisn Mogul Tor
Ector County					
Art West Drlg Co	5	gas	185	—	Crdwll RL
	6	gas	145	—	Crdwll RL
	10	dsl	125	—	Crdwll RL
	11	gaso	65	2000	B Erie 60-L
Glasscock County					
Chas E Hipp Co	17	btne	225	6000	B Erie 48-L
Gray County					
Holt Bros Drlg Co	1	dsl	150	4000	Wlkr-Nr S-33
Grayson County					
Chas E Hipp Co	11	btne	225	6000	B Erie 48L
Hockley County					
Art West Drlg Co	7	gas	145	—	Crdwll RL
Hutchinson County					
Robinson Bros Oil Prod	1	gas	200	4500	B Erie 48-L
Irion County					
James Smith Drlg Co	1	gas	76	1500	B Erie 24-L
	2	LPG	145	3500	B Erie 36-L
Jack County					
Lin-Mour Drlg Co	2	gas	125	6500	Wlkr-Nr C-34
Midland County					
Ray Smith Drlg Co	32	gas-LPG	145	3500	Wlkr-Nr S-32
Mitchell County					
Ellis Drlg Corp	1	btne	45	2400	B Erie 28-L
Willard Gladson & Odstrcil Bros Drlg Co	1	btne	—	5500	B Erie 36-L
	3	btne	—	4200	B Erie 28-L
Montague County					
Baggett Drlg Co	2	Waukesha	145	7000	Wlkr-Nr 34
Palo Pinto County					
Oney Drlg Co	3	LPG	222	5500	Wich 66
Pecos County					
Louis Crouch	1	btne	225	3000	Bucyrus 36
Ed F Henderson	3	gas	145	5000	Wlkr-Nr S-33 Sup
Scurry County					
Ellis Drlg Corp	3	btne	60	4000	B Erie 36-L
Willard Gladson & Odstrcil Bros Drlg Co	2	btne	—	5500	B Erie 36-L
Stephens County					
Chas E Hipp Co	12	btne	145	4000	B Erie 36-L
Tom Green County					
Angelus Drlg Co	1	btne	100	2000	Ft Worth Sup H
Ward County					
Ed F Henderson	1	gas	209	500	Wlkr-Nr S-33 Std
Art West Drlg Co	8	gas	145	—	Crdwll RL
Wichita County					
Baggett Drlg Co	3	dsl	190	7000	Wlkr-Nr C-27
Winkler County					
Ed F Henderson	2	gas	160	3500	Wlkr-Nr S-43
Young County					
Chas E Hipp Co	14	btne	145	4000	B Erie 36-L
F M Johnson Well Serv	1	btne	130	—	Jhnsn 30 Spec
	2	btne	145	—	Clark 30
	3	btne	135	—	Clark 30
	4	btne	145	—	Clark 30 Spec
	5	btne	145	5000	Clark 30 Spec
Oney Drlg Co	2	LPG	145	4000	Wich 61
UTAH					
Uintah County					
Charles M Jameson	1	gas-gaso	—	3500	B Erie 36-L

Contractor's Name	Rig No.	Type Power	HP Driving Engine	Rated Drlg. Depth-Ft.	Rig Make & Model
WEST VIRGINIA					
Mingo County					
Allen Drlg Co	1	gaso	140	3500	B Erie 36-L
	2	gaso	140	3500	B Erie 36-L
	3	gaso	140	3500	Natl Mach
	4	gaso	145	3500	B Erie 36-L
WYOMING					
Weston County					
Prairie Drlg Co	1	btne or nat	290	4000 to 10,000	Crdwll RL-705

Canadian CABLE TOOL

Culver Drlg Co Ltd Box 92 Dunnville Canada

Contractor's Name	Rig No.	Type Power	HP Driving Engine	Rated Drlg. Depth-Ft.	Rig Make & Model
ONTARIO					
Dunville					
Culver Drlg Co Ltd	1	dsl-b.m.c.	80	3000	B Erie 28-L
Lake Erie					
Culver Drlg Co Ltd	2	dsl-b.m.c.	80	1500	B Erie 24-L
	3	dsl-b.m.c.	80	1500	B Erie 24-L

U. S. Well Servicing Contractors

A

Acme Well Serv Co Box 1331 Abilene Tex
Adams Prod Serv 2 Monte Vista Dr Bakersfield Calif
Albright Well Serv Co Box 1192 Hobbs N M
Anderson Oilwell Serv Box 304 McPherson Kans
Atlas Well Serv Inc Box 387 Ft Morgan Colo

B

B & G Well Serv Box 526 Winfield Kans
B-J Well Serv Box 92 Abilene Tex
Geo H Baldwin Oil Well Serv Box 307 Bridgeport Ill
Barnard Well Serv Box 617 Madison Kan
Barnes Bros Well Serv Box 232 Gainesville Tex
Basin Well Serv Inc 2411 Rankin Hwy Midland Tex
Bateman & Whitsitt Inc Box 1956 Hobbs N M
Bayou Well Works Inc Box 78 New Iberia La
Beal Drlg Co Box 124 Ada Okla
Beall Well Serv Co Box 20044 Houston 25 Tex
Beckman Inc Box 1524 Muskogee Okla
Best Well Serv Box 338 Fillmore Calif
Beta Well Serv Ltd 5930 96 St Edmonton Alberta Canada
Billings M E Well Serv Inc 928 E 15th St Casper Wyo
Black Gold Well Serv Box 1427 OCS Lafayette La
Brockett C H Inc Box 1005 Midland Tex

C

C & S Oil Field Serv Co Box 191 Oil City La
California Prod Serv Inc 3252 Cherry Ave Long Beach 7 Calif
Capshaw Well Serv Co Box 1915 Casper Wyo
Carlton Well Serv Box 91 South Houston Tex
Carpenter R L Box 452 Sapulpa Okla
Carter Well Serv Box 178 Pettus Tex
Carter-Jones Drlg Co Inc Box 1597 Kilgore Tex
Chase Well Serv Inc Box 325 Chase Kans
Chris Well Serv Co Ltd 712 Commerce Exchange Bldg Oklahoma City Okla
Christian Inc 712 Commerce Exchange Bldg Oklahoma City 2 Okla
Christian Sarratt & Wallace Ltd 712 Commerce Exchange Bldg Oklahoma City Okla
Clark Well Serv Co Box 4752 Oklahoma City 9 Okla
Clarke Oil Well Serv Co Box 2315 Hobbs N M
Cleaveland Well Serv Box 308 Luling Tex
Clinch Drlg Co Box 27 Hazlehurst Miss
Colo Well Serv Inc Box 122 Rangely Colo
Copeland & Fuller Well Serv Box 237 Kenedy Tex
Crews Well Serv Box 756 Alice Tex

Jess P Cross Drlg Contr 1216 Texas St Graham Tex
Crusader Drlg & Serv Inc Box 851 Springhill La

D

D & J Serv Inc Box 1477 Levelland Tex
D & R Well Serv Box 252 Edmond Okla
D & S Well Serv Co Box 102 Cody Wyo
Devonian Well Serv Box 2821 Odessa Tex
Dickinson R D & Richardson H F DBA Well Service Co Rt 2 Longview Tex
Doe Robert B — Oilfield Serv Rt 1 — 19030 James Rd Bakersfield Calif
Douglas V Downing Well Serv Box 206 Devine Tex
Drilling & Production Co 2907 L St Bakersfield Calif
Duncan E B Drlg & Well Serv Co Inc Box 4096 Shreveport La
Dyer Drlg Co Box 338 Casper Wyoming

E

Eatmon Drlg Co Box 535 Kimball Nebraska
Eichler Well Service Box 515 Jacksboro Tex
Emerson Well Serv & Gen Contrg Box 228 Sulphur Springs Tex

F

Flint Rig Co Box 342 Kimball Neb

G

Gamache Well Serv Ltd 12-11244 116th St Edmonton Alberta Canada
Charles J George Inc Box 1089 Odessa Tex
Glenn Gillespie & Sons Box 907 Cushing Okla
Goswick Leon & Co Box 167 Sweetwater Tex
Gwaltney Henry Drlg Co Box 289 Washington Ind

H

Hamm Dick Drlg Co Box 575 Grandfalls Tex
Harding Well Service Box 1475 Coahoma Tex
Harris Drlg Co Inc Box 868 Eunice La
Hayden & Griffith Oil Well Serv Co 304 Calif Bldg Denver 2 Colo
Odell Herring Well Serv Inc Box 401 Lindsay Okla
Hillier J E Box 67 Pleasanton Tex
Holston Well Serv Inc Box 651 Jennings La
Holt Ivan Well Serv Box 401 Russell Kans

J

J-B Swabbing Co Inc Box 1166 Kilgore Tex
J & M Well Serv Box 445 Mission Tex
Jackson Neil & Sons Star Rt East Artesia N M
Jennings Drlg Co (Alberta) Ltd 528-8 Ave W Calgary Alta Canada
Johnson Drlg & Serv Co Box 3 Magnolia Ark
Johnson F M Well Serv Box 613 Olney Texas

K

K & S Oil Well Serv Inc Box 468 El Campo Tex
Kent Oil Field Serv Inc Box 749 Eldorado Kans
Kent Well Serv Co Drawer 470 Eldorado Kans
Kinsey & Ham Inc 2004 N C St Midland Tex
Knight C E & Co Box 1688 Snyder Tex

L

Light Well Serv 3631 16th St SE Calgary Alberta Canada
Locke Well Serv Box 312 Royalty Tex
Lohmann Oil Well Serv Inc Box 1504 Farmington N Mex

Mc

McAdams J F Box 1716 Hobbs N M
McAlister Well Serv Box 2214 Wichita Falls Tex
McCutchin Gene Well Serv 1401 Mercantile Securities Bldg Dallas Tex
McDaniel Well Serv Box 456 Seminole Okla

M

Mac Drlg Co Box 2972 Houston 1 Tex
Macrate Prod Co 3341 Cherry Ave Long Beach 7 Calif
Maddux Well Serv Box 214 Riverton Wyo
Marrs M L (Mike) Drlg Co Box 985 Drumright Okla
Mercer Jack Well Serv Box 509 Nocona Tex
Moore Petroleum Serv Box 205 Missouri City Tex
Moore Prod Serv 1843 East O St Wilmington Calif
Mumy Well Serv 7941 Patterson Rd Reed City Mich

N

Nichols & Freeman Well Serv Box 183 Grandfalls Tex

O

Oien Oil Corp Box 2235 Cut Bank Mont
Oil Well Serv Co 2405 Orange Ave Long Beach 6 Calif
O'Neil Chas A Well Serv Box 92 Perry Okla

P

Payne Bros Drlg Co Box 15 Lawrenceville Ill
Permian Well Serv Inc Box 37 Wink Tex
Permian Serv Co Inc Box 1477 Levelland Tex
Pool Well Serv Co Box 1940 San Angelo Tex
Post & Brown Well Serv Inc 208 S Main Stafford Kans
Price-Caudle Well Serv Inc Box 453 Seminole Okla
Producers Drlg Co Inc 927 Natl Bk of Comm Bldg New Orleans La

Q

Quad Drlg Co Box 974 Ardmore Okla

R

R O W S Co Inc Box 369 Russell Kans
R & R Well Serv Co Inc Box 637 Rangely Colo
R W I T Drlg Co Box 551 Holdenville Okla
Reames S S Well Serv Box 387 Bloomfield N Mex
Rocket Well Serv 1706 Hill St Alvin Tex
Rodgers Ed Oil Well Serv Box 206 Holyrood Kans

S

Scott's Well Serv Rt 4 Hwy 9E Seminole Okla
Seaboard Well Serv Inc Box 1589 Lafayette La
Seifried Well Serv Box 127 Dewey Okla
Shirer Well Serv Co Box 118 Hoisington Kans
Simpson Wm G Well Serv Box 462 Robinson Ill
Sipes Chas A Well Serv Box 382 Russell Kans
Sitton & Norton Drlg Co 406 Lubbock Natl Bk Bldg Lubbock Tex
Spartan Well Serv 207 S-T Bldg Corpus Christi Tex
Spears Well Serv Inc Box 3187 Victoria Tex
Spur Well Serv Co Box 1325 Houston 1 Tex
Stafford Well Serv Box 147 Linch Wyo
Steitle Drlg Co 1312 Southwood Dr Alice Tex
Stewart's Casing Crew Box 14086 Houston 21 Tex
Sunnyland Contracting Co Inc Box 388 Rayne La

T

T & H Well Serv Co Box 5211 Eunice La
Taylor Dudley Elrod 118 Fifth Ave SE Cut Bank Mont
Texas Well Serv Co Box 191 Borger Tex
Thompson Beuford Prod Maintainers 2620 Bretton Rd Wichita Falls Tex
Todd J R Co Inc Box 168 Odessa Tex
Turner's Well Serv Box 149 Centralia Ill

U

United Oil Well Serv Box 368 Wink Tex

V

Virgil Well Serv Virgil Kans

W

WLB Drlg Co 6635 Chocolate Bayou Rd Houston 2 Tex
W M & W Well Serv Co Box 931 Alice Tex
Wagner J H Drlg Co Box 751 Eldorado Kans
Weaver Well Serv 1301 W Armory Blackwell Okla
Weeks Well Serv Box 367 Susank Kans
Well Serv Inc 1901 E Virginia Ave Victoria Tex
Western Oil Well Serv Co Box 345 Glendive Mont
White Well Serv Box 356 Monahans Tex
Williamson Well Serv Inc Box 3828 Odessa Tex
Winnsboro Serv Co Box 102 Winnsboro Tex
Wood Sam E Box 546 Alvin Tex
Wyoming Well Serv Inc Box 350 Cody Wyo

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MORSE

A BORG·WARNER INDUSTRY

B·W

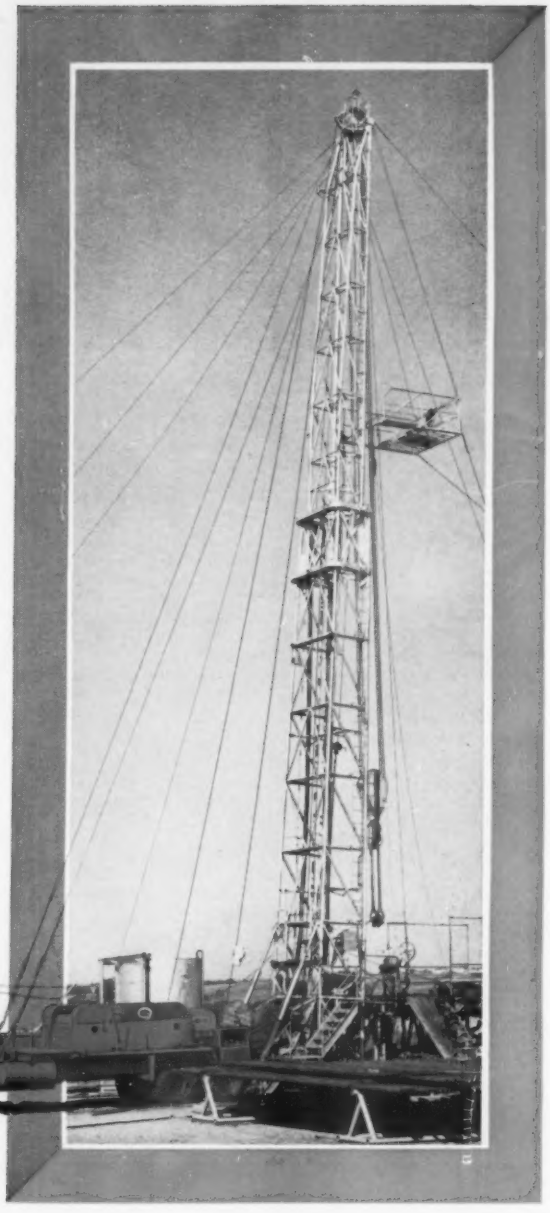
U. S. Contract Well Servicing or Pulling Units

Contractor's Name	Rig No.	Make & Model No. of Unit	How Unit is Transported	No. of Drums	Estimated Capacity Swabbing	Estimated Capacity Pulling	Can Unit Also Drill?
ARKANSAS							
Van Buren							
Chris Well Serv Co Ltd	16	Crdwll KM-250	Truck	2	15,000	19,000/2⅛"	Yes
CALIFORNIA							
Bakersfield							
Adams Prod Serv	1	Wlsn Spr	Trailer	2	10,000	12,000/2" 9,000/2½" 6,000/3"	Yes
Calif Prod Serv Inc	M-21	Hopper	Hoistmobile	2	8,000	8,000	No
	M-22	Hopper	Hoistmobile	2	10,000	10,000	No
Robt B Doe Oilfield Serv	1	Crdwll H	Truck	1	4,500	5,000/2" 4,000/2½" 3,000/3"	No
	2	Crdwll HL	Truck	2	5,500	6,000/2" 5,000/2½" 4,000/3"	No
	3	Hopper	Truck	1	3,000	3,000/2" 2,000/2½" 1,500/3"	No
	4	Hopper	Truck	1	4,000	4,500/2" 3,500/2½" 2,500/3"	No
	5	Hopper	Truck	1	2,500	2,500/2" 1,500/2½" 1,000/3"	No
	6	Hopper IGFA	Truck	2	7,000	7,000/2" 6,000/2½" 5,000/3"	No
	7	Hopper IGFA	Truck	2	9,000	7,000/2" 6,000/2½" 5,000/3"	No
	9	Hopper IGFA	Truck	2	9,000	7,000/2" 6,000/2½" 5,000/3"	No
	10	Hopper	Mobilehoist	2	7,000	7,000/2" 6,000/2½" 5,000/3"	No
Oil Well Serv Co	1-A	Ideco 40	Trailer	2	13,000	13,000/2½" 10,000/3"	Yes
	2-A	Ideco 40	Trailer	2	13,000	13,000/2½" 10,000/3"	Yes
	11	Ideco 30	Trailer	2	10,000	10,000/2½" 8,000/3"	Yes
	12	Crdwll	Trailer	2	5,000	5,000/2½" 4,000/3"	
Castaic							
Calif Prod Serv Inc	D-6	Emsco 500	Truck	2	15,000	15,000	Yes
	H-3	Hopper G	Truck	2	10,000	10,000	Yes
	M-7	Hopper	Hoistmobile	2	8,000	8,000	No
	M-13	Hopper	Hoistmobile	2	10,000	10,000	No
Fillmore							
Best Well Serv	1	Ideco H-35	Self-prop	2	13,000	14,000/2" 14,000/2½" 12,000/3"	No
	2	Wgnr-Mrhse 40-15	Self-prop	2	13,000	14,000/2-2½" 12,000/3"	No
	3	Wgnr-Mrhse T40	Trailer	2	12,000	14,000/2-2½" 12,000/3"	Yes
Kerman							
Oil Well Serv Co	4-A	Ideco 30	Trailer	2	10,000	10,000/2½" 7,000/3"	Yes
	41	Ideco 30	Trailer	2	10,000	10,000/2½" 7,000/3"	
	60	Ideco H-25 CD	Self-prop	2	11,500	10,000	Yes
Kern County							
Drilling & Prod Co	2	Cardwell	Trailer	2	15,000	14,000/2½"	Yes
	3	Ideco	Trailer	2	10,000	6,000/2½"	No
Long Beach							
Calif Prod Serv Inc	D-2	Hopper MTA	Trailer	2	15,000	15,000	Yes
	H-1	Crdwll "R"	Truck	2	10,000	10,000	Yes
	H-10	Wgnr-Mrhse	Truck	2	10,000	10,000	Yes
	H-13	Wgnr-Mrhse	Truck	2	10,000	10,000	Yes
	M-2	Hopper G	Trailer	2	10,000	10,000	Yes
	M-4	Hopper G	Trailer	2	10,000	10,000	Yes
	M-5	Ideco H-30	Trailer	2	10,000	10,000	Yes
	M-6	Hopper G	Trailer	2	10,000	10,000	Yes
	M-8	Wgnr-Mrhse	Trailer	2	10,000	10,000	Yes
	M-14	Hopper	Hoistmobile	2	10,000	10,000	No
Macrate Prod Co	1	Ideco H-30	Trailer	2	10,000	12,000/2" 10,000/2½" 8,000/3"	Yes
	4	Wgnr-Mrhse	Trailer	2	10,000	12,000/2" 10,000/2½" 8,000/3"	No
	6	Wgnr-Mrhse	Trailer	2	10,000	12,000/2" 10,000/2½" 8,000/3"	No
	8	Wgnr-Mrhse	Trailer	2	12,000	14,000/2" 12,000/2½" 10,000/3"	Yes
Oil Well Serv Co	2	Wlsn Mogul	Truck	1		12,000/2½" 6,500/3"	Yes
	3	Ideco	Truck	2	13,000	13,000/2½" 7,000/3"	Yes
	5	Ideco	Truck	2	5,000	5,000/2½" 4,000/3"	Yes
	6	Crdwll	Truck	2	10,000	7,000/2½" 6,500/3"	
	7	Ideco 30	Trailer	2	13,000	13,000/2½" 7,000/3"	Yes
	8	Ideco H-25 AD	Truck	2	11,500	10,000	Yes
	9	Ideco 30	Trailer	2	13,000	13,000/2½" 7,000/3"	Yes
	10	Hydrair	Tractor	2	—	—	
	14	Ideco 30	Trailer	2	13,000	13,000/2½" 7,000/3"	Yes
	15	Ideco 30	Trailer	2	13,000	13,000/2½" 8,000/3"	Yes
	57	Ideco 35	Self-prop	2	13,000	13,000/2½" 8,000/3"	Yes
Ventura							
Calif Prod Serv Inc	D-1	Hopper MTA	Trailer	2	15,000	15,000	Yes
	D-3	Hopper MTA	Trailer	2	15,000	15,000	Yes
	D-4	Hopper MTA	Trailer	2	15,000	15,000	Yes
	D-5	"Oilwell" 66	Truck	2	15,000	15,000	Yes
	H-5	Hopper G	Truck	2	10,000	10,000	Yes
	M-9	Hopper	Hoistmobile	2	10,000	10,000	No
	M-10	Hopper	Hoistmobile	2	10,000	10,000	No
Wilmington							
Moore Prod Serv	1	Crdwll	Trailer	2	6,000	8,000/2" 6,000/2½" 5,000/3"	Yes
	2	Hopper Hoist	Truck	2	10,000	10,000/2" 10,000/2½" 9,000/3"	Yes
	3	Ideco H-30	Trailer	2	12,000	12,000/2" 10,000/2½" 8,000/3"	
COLORADO							
Fort Morgan							
Atlas Well Serv Inc	1	Frnks Rocket	Truck	2	8,000/⅛"	10,000/2"	No
	2	Frnks Explr	Truck	1		10,000/2"	No
	3	Frnks Explor	Truck	2	8,000/⅛"	10,000/2"	Yes
	4	Frnks Rocket	Truck	2	8,000/⅛"	10,000/2"	Yes
Cortez							
R & R Well Serv Co (Colo)	7	Frnks 658-TD	Truck	1	13,500	16,000/2" 12,500/2½" 10,000/3"	Yes
	8	Frnks 65TM	Truck	1	13,500		No
	9	Frnks 658TD Expl	Truck	2	13,500	16,000/2" 12,500/2½" 10,000/3"	Yes
Rangely							
Colo Well Serv Inc	2	Frnks	Truck	2	—	—	
	3	Frnks	Trailer	2	12,000	12,000/2"	Yes
	4	Frnks	Truck	2	12,000	12,000/2"	
	5	Frnks	Truck	2	—	—	
	6	Crdwll	Truck	2	12,000	12,000/2"	Yes
R & R Well Serv Co (Colo)	1	Frnks 658-TD	Truck	1	13,500	16,000/2" 12,500/2½" 10,000/3"	Yes
	2	Frnks 658-TD	Truck	2	13,500	16,000/2" 12,500/2½" 10,000/3"	Yes
	3	Frnks 658-TD	Truck	1	13,500	16,000/2" 12,500/2½" 10,000/3"	Yes
	4	Frnks 658-TD	Truck	1	13,500	16,000/2" 12,500/2½" 10,000/3"	Yes
	5	Frnks 658-TD	Truck	1	13,500	—	No

Contractor's Name	Rig No.	Make & Model No. of Unit	How Unit is Transported	No. of Drums	Estimated Capacity		Can Unit Also Drill?
					Swabbing	Pulling	
	6	Frnks 658-TD	Truck	2	13,500	16,000/2″ 12,500/2½″ 10,000/3″	Yes
	10	Frnks 658-TD	Truck	2	13,500	16,000/2″ 12,500/2½″ 10,000/3″	Yes
	11	Frnks 658-TD	Skid Mtd	1	13,500	16,000/2″ 12,500/2½″ 10,000/3″	No
Sterling							
Hayden & Griffith Oil Well Serv Co Inc	203	Frnks 658-DTD	Truck		10,000	14,000/2″	Yes
	204	Frnks 658-DTD	Truck		10 000	14,000/2″	Yes
	205	Frnks 658	Truck		10,000	14,000/2″	Yes
ILLINOIS							
Bridgeport County							
Geo H Baldwin Oil Well Serv	1	Cooper G-226	Truck	1	—	2,500/3″	No
	3	Cooper G-149	Truck	2	—	2,000	—
Centralia County							
Turner's Well Serv	1	Wlsn Super	Truck	1	6,500	6,500	No
	2	Wlsn Sr	Truck	1	4,000	4,000	No
	3	Wlsn Sr	Truck	1	4,000	4,000	No
	4	Crdwll "Q"	Truck	1	4,000	4,000	No
	5	Ideco	Truck	1	6,500	6,500	No
Lawrenceville County							
Payne Bros Drlg Co	4	Crdwll	Skid	2	2,500	2,500	Yes
	*5	Crdwll	Skid	2	5,000	5,000	Yes
Robinson County							
Wm G Simpson Well Serv	6	Wlsn Jr	Truck	2	2,500	2,500	Yes
	8	Wlkr-Nr	Truck	3	4,000	4,000	Yes
	9	Crdwll HL	Truck	2	4,000	3,500	Yes
INDIANA							
Monroe City							
Gwaltney Drlg Inc	1	Wlsn Spr	Truck	1	4,000	4,000	No
	3	Daney M	Truck	2	1,500	1,500	Yes
	4	Cooper	Skid	3	6,000	6,000	Yes
	2	Crdwll Q	Truck	1	4,000	4,000	No
KANSAS							
Chase							
Chase Well Serv Inc	1	Frnks 4000-TM	Truck	1	—	5,000/2″ 4,500/2½″ 3,600/3″	—
El Dorado							
Kent Well Serv Co Inc	5	Cooper W-45	Truck	1	—	3,500/2″ 3,200/2½″ 2,800/3″	No
	7	Cooper G-226	Truck	3	4,000	4,000/2″ 3,700/2½″ 3,500/3″	Yes
	9	Cooper G-226	Truck	2	4,000	4,000/2″ 3,700/2½″ 3,500/3″	No
	13	Cooper G-226	Truck	3	4,000	4,000/2″ 3,700/2½″ 3,500/3″	Yes
J H Wagner Drlg Co	2	B Erie 36-L	Skid	3	4,500	4,500	Yes
	3	B Erie 36-L	Skid	3	4,500	4,500	Yes
Ellis County							
Ivan Holt Well Serv	2	MZR	Truck	1	—	6,500/2½″	No
Eureka							
Barnard Well Serv	16	Cooper mdl M	Truck	2	3,000	3.000	Yes
Virgil Well Serv	4	Cooper WD	Truck	1	—	3,500	No
	5	Cooper WD	Truck	2	—	3,000	No
Garden City							
Post & Brown Well Serv	23	Crdwll	Truck	1	8,000	7,000/2½″	No
	25	Crdwll	Truck	2	6,000	5,000/2½″	Yes
Great Bend							
Chase Well Serv Inc	2	Frnks TM-44	Truck	1	—	6,000/2″ 5,500/2½″ 4,500/3″	—
Jetmar Well Serv	1	Cooper E-563	Truck	2	7,000	10.000/2″ 8,500/2½″ 7,000/3″	Yes
Hoisington							
Shirer Well Serv Co	1	Crdwll H	Truck	1	—	—	No
	2	Frnks	Truck	1	—	—	No
	3	Crdwll H	Truck	2	—	—	No
Holyrood							
Ed Rodgers Oil Well Serv	1	Crdwll HSKBS	Truck	—	5,000	5,000/2″	No
	2	Cooper E-563	Truck	—	5,000	5,000/2″	No
	3	Crdwll HSKBS	Truck	—	5,000	5,000/2″	No
Larned							
Post & Brown Well Serv	7	Frnks	Truck	1	6,000	5,000/2½″	No
	15	Frnks	Truck	1	7,000	6,000/2½″	No
McPherson							
Anderson Oilwell Serv	1	Crdwll HS	Truck	1	4,500	4,000	No
	2	Crdwll HS	Truck	1	4,500	4,000	No
	3	Frnks Super	Truck	1	4,500	4,500	No
Madison							
Barnard Well Serv	7	Cooper mdl W	Truck	1	—	3,000	No
	9	Cooper mdl W	Truck	1	—	3,000	No
	12	Cooper mdl W	Truck	3	3,000	3,000	Yes
	13	Cooper mdl W	Truck	1	—	3,000	No
	14	Cooper mdl W	Truck	2	3,000	3,000	No
Plainville							
Chase Well Serv Inc	3	Frnks TM-65	Truck	1	—	8,000/2″ 7,000/2½″ 6,000/3″	—
	4	Frnks TM-44	Truck	1	—	6,000/2″ 5,500/2½″ 4,500/3″	—
Pratt							
Chase Well Serv Inc	6	Frnks DTM	Truck	2	6,500	6,000/2″ 5,500/2½″ 4,500/3″	No
	7	Frnks DDM	Self Prop	2	—	8,000/2″ 7,000/2½″ 6,000/3″	—
Russell							
Ivan Holt Well Serv	1	SRKR-6	Truck	1	—	8,000/3½″	No
	3	SRKR-6	Truck	1	—	8,000/2½″	No
	4	Frnks 44-DTM	Truck	2	—	6,500/2½″	No
R O W S Co Inc	4	Crdwll H	Truck	1	5,000	5,000/2″	No
Chas A Sipes Well Serv	2	Crdwll H	Truck	1	—	4,500/2″	No
Stafford							
Post & Brown Well Serv	6	Crdwll	Truck	1	6,000	5,000/2½″	No
	17	Frnks	Truck	1	6,000	5,000/2½″	No
	19	Frnks 44	Truck	1	6,000	5,000/2½″	No
	26	Crdwll	Truck	2	7,000	6,000	No
Susank							
Weeks Well Serv	1	Crdwll H	Truck	1	—	4,000/3″	No
	2	Crdwll H	Truck	1	—	4,000/3″	No
	3	Crdwll H	Truck	2	5,000	4,000/3″	No
Winfield							
B & G Well Serv Co	125	Bucyrus Erie	Skid mntd	3	4,000	5,000	Yes
	94	Crdwll	Truck	1	—	5,000	No
	107	Crdwll Double	Truck	2	4,000	5,000	No
	114	Cooper dble drm	Truck	2	4,000	5,000	No
	121	Crdwll trpl drm	Trailer	3	5,000	6,000	Yes
	114	Crdwll	Truck	1	—	5,000	No
LOUISIANA							
Acadia Parish							
Sunnyland Contr Co Inc	8	Crdwll D	Trailer	1	10,000	13,000	Yes
Claiborne							
Johnson Drlg & Serv Co	1	Beth S-45	Trailer	—	—	4,500/4½″	Yes
Empire							
Bayou Well Works Inc	Bge 2	Frnks	Barge	1	12,500	—	No
Eunice							
Harris Drlg Co Inc	3	Crdwll RL	Skid	2	—	12,000	Yes
	5	Crdwll K	Trailer	1	—	11,000	No
T & H Well Serv Co	1	Wlsn Spr 38	Trailer	—	—	—	Yes
	3	Wlsn Spr	Truck	1	—	10,000/2″ 8,000/2½″	No
	16	Wlsn Spr	Truck	1	12,000	—	No
	18	Wlsn Spr	Truck	1	—	10,000/2″ 8,000/2½″	No
	20	Wlsn Spr	Truck	1	—	10,000/2″ 8,000/2½″	No
	25	Wlsn Spr	Truck	1	12,000	—	No
	30	Wlsn Spr	Truck	1	—	10.000/2″ 8,000/2½″	No
	39	Wlsn Spr 38	Truck	1	10,000	—	Yes
	40	Wlsn Spr	Truck	1	12,300	—	No
	51	Wlsn Spr 38	Truck	1	—	10,000/2½″	Yes
	61	Wlsn Spr 38	self-prop	1	—	10,000/2½″	Yes
Harvey							
Bayou Well Works Inc	122	Wlsn Spr	Truck	1	12,500	—	No
Jennings							
Holston Well Serv Inc	1	Wlsn Spr	Truck	—	—	10.500	No
	2	Wlsn Spr	Truck	—	—	10,500	No
	3	Wlsn Spr	Truck	—	10,500	—	No
	4	Wlsn Spr	Truck	—	—	10,000/2″	No
	5	Wlsn Spr 38	Truck	—	—	13.000/2″	No
	6	Wlsn Spr 38	Truck	—	—	13,000/2″	No

Franks Explorer....

NOW FULLY FIELD PROVEN!



When the Franks Explorer was first introduced to the well servicing industry some two years ago it received immediate acceptance from many contractors. Others assumed a wait-and-see attitude. Why? Because the Explorer was a totally new concept — a self-propelled unit primarily designed as a servicing and workover rig, and mounted on a rugged carrier for secondarily designed to over the road travel. Here was the promise of new speed, more horsepower, greater flexibility. The "wait-and-see" groups settled back to watch.

AND WHAT DID THEY SEE?

Within two short years they saw the Franks Explorer outsell all competition. They saw themselves joining that first group of contractors who accepted the Explorer immediately — who knew Franks' reputation for building good equipment and for delivering what is promised.

If you're still from Missouri, ask the man who owns a Franks' Explorer. Or, better still, call your Franks' representative for all the details.

WELL SERVICING AND DRILLING UNITS

FRANKS

PAMPA, TEXAS

CABOT

CABOT CORPORATION
MACHINERY DIVISION

Worth more when you BUY 'EM . . . Worth more when you TRADE 'EM

Contractor's Name	Rig No.	Make & Model No. of Unit	How Unit is Transported	No. of Drums	Estimated Capacity Swabbing	Estimated Capacity Pulling	Can Unit Also Drill?
	7	Wlsn Spr 38	Truck	—	—	13,000/2"	Yes
	8	Wlsn Mogul '42' Wnchmbl	self-prop	—	—	16,000/2½"	Yes
	9	Wlsn Spr 38	self-prop	1	—	13,000/2"	No
	10	Ideco DIR-300 H-25	self-prop	1	—	13,000/2"	No
	11	Ideco DIR 100-H-25	self-prop	1	—	13,000/2"	No
Lafayette							
Black Gold Well Serv	1	Crdwll H	Skid	1	Concentric Tubing		No
	2	Wlsn	Trailer	1	Concentric Tubing		No
	3	Crdwll L	Skid	1	Concentric Tubing		No
Seaboard Well Serv Inc	1	Wlsn Mogul	Truck	1	—	14,000/2½"	No
Many							
E B Duncan Drlg & Well Servicing Co Inc	1	Frnks 5000	Truck	1	—	6,500/2½"	Yes
Morgan City							
Bayou Well Works Inc	124	Brwstr	Truck	1	15,000	—	No
New Iberia							
Bayou Well Works Inc	51	Wlsn	Truck	1	12,000	—	No
	70	Wlsn Spr	Truck	1	12,500	—	No
Oil City							
C & C Oil Field Serv Co	1	Wlsn Sr	Truck	2	5,000	5,000/2"	Yes
	2	Wlsn Sr	Truck	2	5,000	5,000/2"	Yes
	3	Wlsn Sr	Truck	1	—	5,000/2"	Yes
	4	Wlsn Sr	Truck	1	—	5,000/2"	Yes
	5	Wlsn Sr	Truck	1	—	5,000/2"	Yes
	6	Wlsn Sr	Truck	1	—	5,000/2"	Yes
	7	Wlsn Sr	Truck	1	—	5,000/2"	Yes
	8	Wlsn Sr	Truck	2	5,000	5,000/2"	Yes
Ouachita							
Johnson Drlg & Serv Co	2	Beth S-55	Trailer	—	—	6,500/4½"	Yes
Springhill							
Crusader Drlg & Serv Inc	4	Wlsn Spr	Truck	1	—	6,500/2½"	Yes
	5	Wlsn Spr	Truck	2	10,000	6,500/2½"	Yes
	7	Wlsn Spr	Truck	1	10,000	—	No
	8	Wlsn Spr	Truck	1	—	8,500/2½"	Yes
	11	Wlsn Spr 38	Truck	1	—	10,000/2½"	Yes
	13	Wlsn Spr	Truck	1	—	6,500/2½"	Yes
Venice							
Bayou Well Works Inc	Bge 1	Wlsn	Skid	1	14,000	—	No
Clinch Drlg Co	1	Emsco 350	Inland bge	2	10,000	15,000	Yes
MICHIGAN							
Reed City							
Mumy Well Serv	2	Crdwll H	Truck	1	6,000	5,000	No
	3	Frnks 1046	Truck	1	6,000	5,000	No
	4	Crdwll O	Truck	1	5,000	35,000	No
	5	Cooper M	Truck	1	6,000	5,000	No
MONTANA							
Cut Bank							
Dudley Elrod Taylor	1	Western Gnt	Truck	2	4,000 8,000 8,000	4,000/2½"	—
	3	Crdwll AH	Truck	2	7,000	5,000/2½"	—
	4	Frnks 26	Truck	1	—	3,200/2½"	No
	5	Frnks RD-190	Truck	1	14,000/5/16	10,000/2½"	—
Glendive							
Western Oil Well Serv Co	1	Wlsn Torcair	Truck	—	14,000	14,000	Yes
	3	Wlsn Mogul	Truck	—	12,000	12,000	No
	5	Cooper 42-10	self-prop	2	14,000	14,000	No
Poplar							
Western Oil Well Serv Co	2	Wlsn Spr 38	Truck	—	12,000	12,000	No
	4	Wlsn Spr 38	Truck	—	12,000	12,000	Yes
Stillwater County							
Oien Oil Corp	3	Natl T-20	skd	1	7,000	10,000	Yes
Toole County							
Oien Oil Corp	4	Beth S-50	skd	1	3500	4,000	Yes
NEBRASKA							
Kimball							
Eatmon Drlg Co	4	Frnks 658	Truck	2	8,000	8,000	Yes
	5	Wlsn Mogul	Truck	2	12,000	12,500	Yes
	6	Wlsn Super	Truck	2	7,000	7,000	Yes
Hayden & Griffith Oil Well Serv Co Inc	201	Frnks 658 DTD	Truck	—	10,000	14,000/2"	Yes
R O W S Co Inc	5	Crdwll K-200	Truck	2	12,000	12,000/2"	No
	6	Crdwll K-200	Truck	2	12,000	12,000/2"	No
	7	Hopper GxxA	Truck	2	15,000	15,000/2"	No
McCook							
R O W S Co Inc	1	Crdwll H	Truck	1	5,000	5,000/2"	No
	2	Crdwll K-200	Truck	2	12,000	12,000/2"	No
	3	Crdwll H	Truck	1	5,000	5,000/2"	No
	8	Wlsn	Truck	2	12,000	12,000	No
NEW MEXICO							
Artesia							
Neil Jackson & Sons	1	Wlsn	Truck	1	4,000	—	No
	3	Wlsn Mogul	Truck	2	8,000	8,000	No
	4	Frnks 658-137	Truck	2	12,000	12,000/2½"	No
Bloomfield							
S S Reames Well Serv	9	Crdwll A-151	self-prop	2	6,000	—	No
	11	Crdwll KM-210	self-prop	2	10,000	—	Yes
Farmington							
Calif Prod Serv Inc	H-4-M	—	—	—	—	—	—
	H-9-M	—	—	—	—	—	—
Lohmann Oil Well Serv Inc	12	White 1283	Truck	—	10,500	10,500	No
	16	Intl L-190	Truck	—	10,500	10,500	No
	18	Frnks Sr	Truck	—	12,000	12,000	Yes
	25	Frnks Expl	Truck	—	15,000	15,000	Yes
	30	Frnks Cr Expl	dsl Expl Car	2	12,000	12,000	No
Hobbs							
Albright Well Serv Co	12	Frnks 658	Truck	2	13,000	10,000	No
	23	Frnks 658	Truck	2	13,000	10,000	No
	27	Frnks 658	Truck	2	13,000	10,000	No
	34	Frnks 658	Truck	2	13,000	10,000	No
	49	Frnks Rocket	Truck	2	13,000	15,000	No
	44	Frnks Rocket	Truck	2	13,000	15,000	No
Bateman & Whitsitt Inc	1	Hopper Hoistmobile GXTA	self-prop	2	15,000	15,000/2" 13,000/2½" 10,000/3"	Yes
	5	Hopper Hoist GXXA	self-prop	2	15,000	15,000/2" 13,000/2½" 10,000/3"	No
	10	Hopper GXFA	self-prop	2	15,000	14,000/2" 12,000/2½" 9,000/3"	No
	15	Frnks 658	self-prop	2	13,000	13,000/2"	No
	20	Frnks 658	self-prop	2	23,000	13,000/2"	No
	25	Frnks	self-prop	1	13,000	—	No
	30	Frnks 658	self-prop	2	13,000	13,000/2"	No
	40	Frnks 658	self-prop	2	13,000	13,000/2"	No
	45	Hopper GXFA	Truck	2	15,000	14,000/2" 12,000/2½" 9,000/3"	No
	50	Hopper CXFA	Truck	2	15,000	14,000/2" 12,000/2½" 9,000/3"	No
	55	Frnks 658	Truck	2	13,000	13,000/2"	No
	65	Frnks 658	Truck	2	13,000	13,000/2"	No
Clarke Oil Well Serv	1	Frnks 658	Truck	2	13,000	14,000/2"	No
	5	Frnks 658	shop built carrier	2	13,500	13,500/2"	No
	7	Frnks	Truck	2	13,500	13,500/2"	No
	9	Frnks 658	Truck	2	13,500	13,500/2"	No
	10	Frnks 658	Truck	2	13,500	13,000/2"	No
J F McAdams	38	Frnks 658	Truck	2	13,000	13,000	No
	39	Frnks 658	Truck	2	13,000	13,000	No
	47	Hooper	Truck	2	13,000	13,000	No
	64	Frnks 658	Truck	2	13,000	13,000	No
	65	Frnks 658	Truck	2	13,000	13,000	No
	82	Frnks 658	Truck	2	13,000	13,000	No
	83	Frnks Explorer	self-prop	2	13,000	13,000	No
	Derrick 85	Wlsn Mogul	self-prop	2	13,000	13,000	No
Jal							
Clarke Oil Well Serv Co	2	Frnks 658	Truck	2	10,000	14,000/2"	No
	3	Frnks 658	Truck	2	13,500	13,500/2"	No
	4	Frnks 658	Truck	2	13,500	13,500/2"	No
Lovington							
Clarke Oil Well Serv Co	6	Frnks	Truck	—	15,000	15,000/2"	No
	8	Hopper	self-prop	2	15,000	15,000/2"	No
OHIO							
Canton							
Glenn Gillespie & Sons	8	Cooper Skytop	self-prop	1	—	10,000	Yes
OKLAHOMA							
Ada							
Beal Drlg Co	1	Crdwll	Skid	2	10,000	10,000	Yes
	2	Wlkr-Nr 43	Trailer	3	4,500	4,500	Yes
	3	Special Wlkr-Nr	Trailer	3	3,500	3,500	Yes
Blackwell							
Weaver Well Serv	1	Frnks DTM-44	Truck	2	7,800	7,500/2" 7,500/2½" 6,000/3"	No
	1	Wlkr-Nr S-43	Trailer	3	5,500	6,000/2" 5,000/2½" 5,000/3"	Yes
	2	Crdwll H	Truck	1	—	6,500/2" 5,500/2½"	No

Contractor's Name	Rig No.	Make & Model No. of Unit	How Unit is Transported	No. of Drums	Estimated Capacity		Can Unit Also Drill?
					Swabbing	Pulling	
	2	Frnks DTM-65	Truck	2	7,800	7,800/2″ 7,500/2½″ 6,000/3″	No
	2	Wlkr-Nr	Trailer	3	5,500	6,000/2″ 5,000/2½″ 5,000/3″	Yes
	3	Frnks DTM-44	Truck	2	7,800	7,500/2″ 7,500/2½″ 6,000/3″	No
	4	Frnks DTM-44	Truck	2	7,800	7,800/2″ 7,500/2½″ 6,000/3″	No
	5	Frnks DTM-44	Truck	2	7,800	7,500/2″ 7,500/2½″ 6,000/3″	No
Dewey							
Seifried Well Serv	2	Cooper 226	Truck	1	—	3,000	No
	3	Cooper 226	Truck	2	3,000	3,000	No
	4	Cooper 226	Truck	1	—	3,000	No
	5	Crdwll	Truck	1	—	3,500	No
	6	Cooper 226	Truck	2	3,000	3,000	No
	7	Cooper 226	Truck	1	3,000	3,000	No
Drumright							
M L "Mike" Marrs Drlg Co	1	B Erie	Trailer	3	3,500	—	Yes
	2	B Erie 36-L	Trailer	3	4,000	—	Yes
	4	B Erie 36-L	Trailer	3	400	—	Yes
Edmond							
D & R Well Serv Inc	1	Frnks 658	Truck	2	—	—	Yes
	2	Frnks 658	Truck	2	—	—	Yes
	3	Frnks 658	Truck	2	—	—	Yes
	4	Frnks 658	Truck	2	—	—	Yes
Hennessey							
Christian Sarratt & Wallace Ltd	81	Frnks 658	Truck	2	11,500	15,000/2⅛″	Yes
	83	Frnks 658	Truck	2	10,000	7,000	Yes
Chris Well Serv Co Ltd	4	Frnks 658	Truck	2	11,500	14,000/2⅛″	No
	8	Frnks 658	Truck	2	11,500	14,000/2⅛″	No
	14	Frnks 658	Truck	2	11,500	14,000/2⅛″	Yes
Clark Well Serv Co	34	Crdwll KM-20	—	2	—	—	—
Christian Inc	101	Frnks 658	Truck	2	11,500	12,500/2⅛″	No
	105	Crdwll KM-250	Truck	2	11,500	15,000/2⅛″	Yes
Holdenville							
R W I T Drlg Co	1	Mayhew 1000	Mtd	—	—	1,500/2¾″	—
	1	Brwstr N-3	—	—	—	3,750/3½″	—
Lindsay							
Chris Well Serv Co Ltd	3	Frnks 658	Truck	2	11,500	14,000/2⅞″	No
	5	Frnks 658	Truck	2	11,500	14,000/2⅞″	No
	6	Frnks 658	Truck	2	11,500	14,000/2⅞″	No
	20	Crdwll KM-250	Truck	2	15,000	19,000/2⅞″	Yes
Christian Sarratt & Wallace Ltd	80	Crdwll KM-250	Truck	2	15,000	19,000/2⅞″	Yes
	82	Frnks 658	Truck	2	11,500	15,000/2⅞″	Yes
	84	Frnks 658 Tri-Scope	—	2	11,500	15,000/2⅞″	—
Odell Herring Well Serv Inc	3-A	Frnks 658	Truck	2	15,000	13,500/2½″	No
	4	Frnks 658	Truck	2	13,500	12,500/2½″	No
	5	Frnks 658	Truck	2	13,500	12,500/2½″	No
	16	Frnks Rocket	Truck	2	13,500	15,000/2½″	Yes
Oklahoma City							
Clark Well Serv Co	18	Frnks 44-DD	Truck	—	9,000	9,000	No
	20	Frnks 658 DD	Truck	—	12,000	12,000/2″	No
	21	Frnks 658 DD	Truck	—	12,000	12,000/2″	No
	22	Frnks 44 SD	Truck	—	10,000	—	No
	24	Frnks 658 DD	Truck	—	12,000	12,000/2″	No
	27	Frnks 658 DD Rkt	Truck	—	12,000	12,000/2″	Yes
	32	Frnks 658 DD Rkt	Truck	—	12,000	12,000/2″	Yes
	33	Frnks 658 DD	Frnks Expl	—	12,000	12,000/2″	No
Pawhuska							
Kent Oil Field Serv Inc	1	Cooper W-45	Truck	2	3,500	3,500/2″ 3,200/2½″ 2,800/3″	No
	2	Cooper P-32	Truck	3	4,500	5,000/2″ 4,500/2½″ 4,000/3″	Yes
	3	Cooper G-226	Truck	2	4,000	4,000/2″ 3,700/2½″ 3,500/3″	No

the most compact tubing tong on the market!

HILLMAN-KELLEY

Model 4600-H "Bobtail"

NEW, COMPACT POWER TUBING TONG presented by HILLMAN-KELLEY offers more speed and efficiency for modern, highspeed well servicing operations. The Model 4600-H "Bobtail" hydraulic power tubing tong is 26% more compact than any other tong on the market.

Front-end controls permit the tong to be operated from the front, thus saving the time required to walk around to the side of the tong. Front-end controls are especially designed for use with an automatic retractor. Tongs may also be operated from the side in the conventional manner.

The jaw design ratios the gripping action to the torque applied. No matter what torque is required, or how tight the makeup, these jaws positively will not crush API tubing. The ratioed gripping action also minimizes die cutting or gouging – an important advantage with the new high-strength tubing. The six-point grip of the jaws uniformly distributed around the pipe on 2⅞″, 3½″ and 4½″ o.d. tubing further minimizes die marking and cutting.

- jaw sizes for tubing from 1.050″ thru 4½″ O.D.
- length 42″; width 29″; weight 490 lbs.

Hillman-Kelley leads the field in the manufacture of Tubing Tongs, Casing Tongs, Sucker Rod Wrenches and Power Units.

HILLMAN-KELLEY

Main Office & Plant: 1000 Macy Street, Los Angeles 33, California
Division Office: 5959 Clinton Drive, Houston 20, Texas
Branch Offices: Odessa, Corpus Christi, Texas • Bakersfield, Calif.
Oklahoma City, Okla. • Lafayette, Shreveport, La.

Contractor's Name	Rig No.	Make & Model No. of Unit	How Unit is Transported	No. of Drums	Estimated Capacity Swabbing	Estimated Capacity Pulling	Can Unit Also Drill?
	4	Cooper G-226	Truck	2	4,000	4,000/2″ 3,700/2½″ 3,500/3″	No
	6	Cooper W-45	Truck	1	—	3,500/2″ 3,200/2½″ 2,800/3″	No
	8	Cooper W-45	Truck	2	3,500	3,500/2″ 3,200/2½″ 2,800/3″	No
	10	Cooper W-45	Truck	1	—	3,500/2″ 3,200/2½″ 2,800/3″	No
	11	Cooper W-45	Truck	1	—	3,500/2″ 3,200/2½″ 2,800/3″	No
	12	Cooper W-45	Truck	2	—	3,500/2″ 3,200/2½″ 2,800/3″	No
Perry County							
Chas O'Neil Well Serv Inc	1	Frnks 65	Truck	1	—	7,200/2″	No
	2	Frnks 87	Truck	2	9,000	8,700/2″	No
	3	Frnks 658	Truck	2	8,500	7,200/2″	No
Sapulpa							
R L Carpenter	1	Cooper W	Truck	1	3,000	3,000/2″ 2,500/2½″ 2,000/3″	No
Seminole							
McDaniel Well Serv	1	Frnks 65-DTM	Truck	2	6,500	10,000/2″ 6,500/2½″	No
	2	Frnks 65-DTM	Truck	2	6,500	10,000/2″ 6,500/2½″	No
	3	Frnks 44-DTM	Truck	2	5,500	10,000/2″ 6,500/2½″	No
Price-Caudle Well Serv Inc	1	Frnks 65	Truck	1	—	10,000/2″ 10,000/2½″ 10,000/3″	No
	3	Frnks 44	Truck	2	8,000	10,000/2″ 10,000/2½″ 10,000/3″	Yes
Scott's Well Serv	6	Frnks 65	Truck	2	9,000/⅞″	8,000/2½″	No
	7	Frnks 65	Truck	1	—	8,000/2½″	No
	8	Frnks 44	Truck	1	—	6,000/2½″	No
	9	Frnks 44	Truck	2	7,000/⅞″	6,000/2½″	No
Wilson							
Quad Drlg Co	1	Frnks Gnt Clpr	self-prop	2	14,000	14,000	Yes
Woodward							
Christian Inc	102	Frnks 658	Truck	2	11,500	12,500/2⅜″	No
	104	Frnks 658	Truck	2	11,500	12,500/2⅜″	Yes
	106	Frnks 658	Truck	2	11,500	12,500/2⅜″	No
	107	Frnks 658	Truck	2	15,000	12,500/2⅜″	No
Pool Well Serv Co	15	Wlsn Spr 38 w/derrick 66′	Truck	2	12,000	12,000/2½″	No
	32	Wlsn Super 38 w/derrick 90′	self-prop	2	12,000	12,000/2½″	No
	40	Wlsn Super 38 w/derrick 90′	self-prop	2	12,000	12,000	No
	42	Wlsn Super 38 w/derrick 90′	self-prop	2	12,000	12,000	No

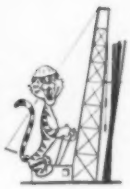
TEXAS

Contractor's Name	Rig No.	Make & Model No. of Unit	How Unit is Transported	No. of Drums	Estimated Capacity Swabbing	Estimated Capacity Pulling	Can Unit Also Drill?
Abilene							
B-J Well Serv	2	Wichtex C-65	Truck	2	8,000	8,000/2″ 6,000/2½″ 5,000/3″	No
	3	Wichtex C-60	Truck	2	6,000	6,000/2″ 4,500/2½″ 3,800/3″	No
	4	Wichtex C-65	Truck	2	8,000	8,000/2″ 6,000/2½″ 5,000/3″	No
	5	Wichtex C-65	Truck	2	8,000	8,000/2″ 6,000/2½″ 5,000/3″	No
	6	Wichtex C-60	Truck	2	6,000	6,000/2″ 4,500/2½″ 3,800/3″	No
	7	Wichtex C-65	Truck	—	8,000	8,000/2″	Yes
	8	Wichtex C-60	Truck	2	6,000	6,000/2″ 4,500/2½″ 3,800/3″	—
	9	Wichtex C-60	Truck	2	6,000	6,000/2″ 4,500/2½″ 3,800/3″	—
Alice							
Crews Well Serv	3	Wlsn Spr 38	Trailer	2	8,000	10,000	Yes
Steitle Drlg Co	1	Wlsn Mogul 42	Trailer	2	13,500	15,000/2″	Yes
W M & W Well Serv Co	1	Wlsn Spr	Truck	2	7,000	7,000/2″ 6,000/2½″ 5,000/3″	Yes
W M & W Drlg Co	9	Wlsn Mogul	Skid	2	8,500	12,500/2″ 9,000/2½″	Yes
Alvin							
Sam E Wood	1	Ideco H-20	Truck	2	—	11,000/2″ 9,000/2½″	Yes
Andrews							
D & J Serv Inc	6	Frnks Expl	self-prop	2	14,000	14,000/2″ 13,000/2½″ 12,500/3″	Yes
	7	Frnks Expl	self-prop	2	14,000	14,000/2″ 13,000/2½″ 12,500/3″	Yes
	17	Frnks Expl	self-prop	2	14,000	14,000/2″ 13,000/2½″ 12,500/3″	Yes
Devonian Well Serv	9	Frnks 658	Truck	2	14,000	14,000	No
	10	Frnks 658	Truck	2	14,000	14,000	No
Permian Serv Co Inc	10	Wlsn Spr 38	Truck	2	12,500	12,500/2″ 10,000/2½″ 6,000/3″	No
	12	Wlsn Spr 38	Truck	2	12,500	12,500/2″ 10,000/2½″ 6,000/3″	No
	14	Wlsn Spr 38	Truck	2	12,500	12,500/2″ 10,000/2½″ 6,000/3″	No
Pool Well Serv Co	11	Wlsn Spr 38 w/derrick 66′	Truck	2	12,000	12,000/2½″	No
	12	Wlsn Spr 38 w/derrick	Truck	2	12,000	12,000/2½″	No
	23	Wlsn Spr	Truck	1	10,000	—	No
	28	Wlsn Spr 38	Truck	2	12,000	12,000/2½″	No
	30	Wlsn Spr 38 w/derrick 90′	Truck	2	12,000	12,000/2½″	No
	38	Wlsn Mogul 42 w/derrick 96′	self-prop	2	14,000	14,000	No
Williamson Well Serv Inc	21	Frnks 658	Truck	2	13,500	13,500/2½″	No
	22	Frnks 658	Truck	2	13,500	13,500/2½″	No
	26	Frnks 658	Truck	2	13,500	13,500/2½″	No
	33	Frnks 658	Truck	2	13,500	13,500/2½″	No
	35	Frnks 658	Truck	2	13,500	13,500/2½″	No
Anson							
Pool Well Serv Co	7	Wlsn Spr	Truck	2	10,000	8,000/2½″	No
Archer City							
Galloway Bros	4	Wichita Engr	Truck	—	—	—	No
Barber's Hill							
Moore Petroleum Serv	2	Crdwll K	Truck	2	10,000	8,600	Yes
Bay City							
K & S Oil Well Serv Inc	103	Frnks 65-TD	Truck	—	9,000	9,000/2″	No
Spur Well Serv Co	3	Frnks 137	Truck	1	—	15,000/2½″	Yes
	4	Frnks 658-TD	Truck	1	—	15,000/2½″	Yes
Baytown							
Rocket Well Serv	4	Frnks Expl	Truck	—	12,000	12,000/2″	Yes
Big Lake							
Pool Well Serv Co	2	Wlsn Spr 38 w/derrick 66′	Carrier	2	12,000	12,000/2½″	No
	3	Wlsn Spr	Truck	2	10,000	8,000/2½″	No
	5	Wlsn Spr w/derrick 66′	Truck	2	10,000	8,000/2½″	No
	10	Wlsn Spr 38 w/derrick 66′	Truck	2	12,000	12,000/2½″	No
	17	Wlsn Mogul 42 w/derrick 90′	Trailer	2	14,000	14,000/2½″	Yes
	24	Wlsn Spr	Truck	1	10,000	—	No
	25	Wlsn Spr 38 w/derrick 90′	Trailer	2	12,000	12,000/2½″	No
Boling							
Producers Well Serv Inc	6	Cooper T-38	Truck	1		8 000/2½″	Yes
	7	Skytop	Self-prop	1		10,000/2½″	Yes
Bryson							
Eichler Well Serv	5	Wichtex C-65	Truck	2	6,000	6,000/2″	No
	6	Wichtex C-65	Truck	2	6,000		Yes
Coahoma							
Harding Well Serv Co	3	Wilson Sr	Truck	2	6,000	5,000	No
	7	Wlsn Sup	Truck	2	10,000	10,000	No
	10	Wlsn Sr	Truck	2	6,000	5,000	No

Contractor's Name	Rig No.	Make & Model No. of Unit	How Unit is Transported	No. of Drums	Estimated Capacity Swabbing	Estimated Capacity Pulling	Can Unit Also Drill?
	12	Wlsn Sup	Truck	—	10,000	10,000	No
	14	Wlsn Sr	Truck	2		6,000	No
Corpus Christi							
Spartan Well Serv	1	Crdwll KL	Truck	1	6,000	10,000/2″ 8,000/2½″ 6,500/3″	Yes
Crane							
Gene McCutchin	2	Wilson	Truck	2	13,000	14,000	Yes
J R Todd Co Inc	4	Crdwll AL	Truck	2	9,000	8,000/2″ 6,000/2½″ 4,500/3″	No
	6	Crdwll K-200	Truck	2	13,000	13,000/2″ 12,000/2½″ 10,000/2″	Yes
	7	Crdwll K-200	Truck	2	13,000	13,000/2″ 12,000/2½″ 10,000/3″	Yes
	8	Crdwll K-200	Truck	2	13,000	13,000/2″ 12,000/2½″ 10,000/3″	Yes
	9	Crdwll K-200	Truck	2	13,000	13,000/2″ 12,000/2½″ 10,000/3″	Yes
Denver City							
Williamson Well Serv Inc	13	Frnks 658	Truck	2	13,500	13,500/2½″	No
	19	Frnks 658	Truck	2	13,500	13,500/2½″	No
	27	Frnks 658	Truck	2	13,500	13,500/2½″	No
Devine							
Douglas V Downing Well Serv & Drlg	1	Border	Truck	2	5,000	—	No
	2	Wlsn Super	Truck	2	5,000		Yes
	3	Wlsn Super	Truck	2	7,500	—	Yes
	4	Wlsn Super	Truck	2	10,000	—	Yes
	6	Wlsn Super	Truck	2	7,500	—	Yes
	7	Wlsn Super	—	—	10,000	—	Yes
De Witt County							
W M & W Well Serv Co	5	Wlsn Super	Truck	2	7,500	6,500/2″	Yes
El Campo							
K & S Oil Well Serv Inc	1	Wlsn Spr	Truck	—	—	10,000	No
	2	Frnks 65	Truck	—	—	9,000	Yes
	3	Wlsn Spr	Truck	—	—	10,000	No
	4	Wlsn Spr	Truck	—	—	10,000	No
	5	Wlsn Spr	Truck	—	—	10,000	No
	7	Frnks 65	Truck	—	—	9,000	Yes
	8	Wlsn Spr	Truck	—	—	10,000	No
	9	Wlsn Spr	Truck	—	—	10,000	No
	10	Frnks	Truck	—	—	12,000	No
	11	Frnks	Truck	—	—	10,000	No
	104	Wlsn Spr	Truck	1	—	10,000	No
	106	Frnks	Truck	—	9,000	9,000/2″	No
	107	Frnks 65-TD	Truck	—	9,000	9,000/2″	No
Fort Bend							
Moore Petroleum Serv	4	Crdwll M200	Self-prop	2	10,500	12,000	Yes
	5	Crdwll L	Trailer	2	10,500	12,000	Yes
	7	Crdwll M200	Self-prop	2	10,500	12,000	Yes
Freer							
D V Downing Well Serv & Drlg	5	Frnks	Truck	2	5,000	—	No
Gainesville							
Barnes Bros Well Serv	3	Clark 70 S	Trailer	—	6,500	6,500/2″	Yes
	4	Wichtex E-75	Truck	2	10,000	10,000/2″	No
	6	Wichtex C-65	Truck	2	9,000	9,000/2″	No
	7	Wichtex C-65	Truck	2	7,500	7,500/2″	No
	10	Frnks Comet	Trailer	—	15,000	15,000/2″	Yes
	11	Frnks	Truck	2	15,000	16,000/2⅛″	Yes
Goose Creek							
Moore Petroleum Serv	1	Crdwll K	Truck	1	8,000	—	Yes
	3	Crdwll K	Skid	2	8,000	8,000	Yes
	8	Wlsn Mogul	Skid	1	5,000	5,000	Yes
Graham							
Jess P Cross Drlg Contr	1	Wlsn Giant	Skid	1	—	—	Yes
Grandfalls							
Dick Hamm Drlg Co	1	Wlkr-Nr S-32	Trailer	3	6,500	6,500	Yes
	2	Wlkr-Nr C-33	Truck	3	3,500	3,500	Yes
	3	B Erie 36-L	Trailer	3	4,500	4,500	Yes
Nichols & Freeman	4	Wlsn	Truck	2	5,000	5,000	No
	6	Wlsn	Truck	2	5,000	5,000	No
	n14	Wlsn	Truck	2	4,000	4,000	No
	15	Wlsn	Truck	1	—	4,500	No
	20	Wlsn Sr	Truck	dbl	9,000	9,000	Yes
Levelland							
D & J Serv Inc	8	Frnks Expl	Self-prop	2	14,000	14,000/2″ 13,000/2½″ 12,500/3″	Yes
Permian Serv Co Inc	15	Wlsn Spr	Truck	2	10,000	8,500/2″ 6,000/2½″ 5,000/3″	No
	16	Frnks 44	Truck	2	10,500	9,000/2″ 6,500/2½″ 5,500/3″	No
	18	Frnks 658	Truck	2	13,000	13,000/2″ 11,000/2½″ 7,500/3″	No
Liberty							
K & S Oil Well Serv Inc	101	Frnks 65TD	Truck	—	9,000	9,000/2″	No
	102	Frnks 65TD	Truck	—	9,000	9,000/2″	No
	105	Frnks	Truck	1	12,000	—	No
	108	Frnks 65TD	Truck	—	9,000	9,000/2″	No
Littlefield							
Sitton & Norton Drlg Co	1	Wlsn Giant	Skid	1	—	—	Yes
Hardin							
Beall Well Serv Co	2	Natl T-8	Truck	1	—	10,000	No
	4	Natl T-8-S	Truck	2	8,000	10,000	No
Harris							
Beall Well Serv Co	3	Crdwll KS	Truck	—	6,500	10,000/2″	No
Houston							
Carlton Well Serv	1	Frnks	Truck	1	10,000	—	No
	2	Frnks	Truck	1	10,000	—	No
	4	Frnks Hyd	Truck	1	10,000	—	No
Mac Drlg Co	5	Beth S-45-E	Trailer	2	7,000	20,000/2″ 16,000/2½″ 13,000/3″	Yes
Stewart's Casing Crew	1	Cooper E	Truck	1	—	8,000/2″ 6,500/2½″	Yes
	3	Cooper 420	Truck	1	—	11,000/2″ 9,000/2½″	Yes
	5	Cooper 420	Truck	1	—	11,000/2″ 9,000/2½″	Yes
	6	Cooper 420	Truck	1	—	11,000/2″ 9,000/2½″	Yes
	7	Cooper TR-42	Truck	1	—	10,000/2″ 8,000/2½″	No
	8	Cooper AP-138	Truck	1	—	10,000/2″ 8,000/2½″	No
	9	Frnks	Skid	1	—	10,000/2″ 8,000/2½″	Yes
WLB Drlg Co	2	Wlsn U-34	Trailer	1	—	20,000/2″ 18,000/2½″ 6,000/3″	Yes
Imperial							
Kinsey & Ham Inc	1	Crdwll L	Trailer	2	13,500	13,500/2″	Yes
Kenedy							
Copeland & Fuller Well Serv	2	Cooper 38	Truck	2	9,000	11,000/2″ 9,500/2½″	Yes
	3	Wlsn Super 38	Truck	2	9,000	10,000/2″ 8,500/2½″	Yes
Kilgore							
Carter-Jones Drlg Co Inc	1	Wlsn Super	Truck	1	10,000	7,500	No
	2	Wlsn Super	Truck	1	10,000	7,500	No
J-B Swabbing Co Inc	1	Wlsn Giant	Skid	1	—	14,000/2″	Yes
	2	Wlsn Super	Truck	1	—	6,000/2″	No
	3	Cooper E	Tractor	1	—	6,000/2″	No
	5	Wlsn Super	Truck	1	—	6,000/2″	No
	6	Wlsn Super	Truck	1	—	6,000/2″	No
	7	Wlsn Super	Truck	1	10,000	6,000/2″	No
	8	Wlsn Super	Truck	1	—	6,000/2″	No
	9	Wlsn Mogul	Skid	1	—	10,000/2″	Yes
	19	Wlsn Super	Truck	1	—	6,000/2″	No
	30	Wlsn Spr 38	Truck	1	—	12,500/2″	Yes
Longview							
W M & W Well Serv Co	7	Wlsn 38	Truck	2	8,500	8,800/2″ 7,500/2½″	Yes
R D Dickinson & H F Richardson DBA Well Serv Co	1	Wlsn Super	Truck	—	—	8,500	No
	2	Wlsn Super	Truck	—	—	8,500	No
	3	Wlsn Super	Truck	—	7,000	—	No
	4	Wlsn Super	Truck	—	5,500	—	No
Luling							
Cleaveland Well Serv	1	Frnks 33TM	Truck	1	—	4,500/2″	No
	2	Crdwll AH	Truck	2	5,000	6,000/2″	Yes
	3	Frnks 33TM	Self-prop	1	—	3,500/2″	No
	4	Frnks 65TM	Self-prop	1	—	6,500/2½″	No
Midkiff							
Pool Well Serv Co	9	Wlsn Super w/derrick 66′	Truck	2	10,000	8,000/2½″	No
	31	Wlsn Super 38 2/Drk 66′	Self-prop	2	12,000	12,000	No

TIGER ON THE SPOT IN THE OIL FIELDS

This is the line with the PETROFIBER Core that outperforms and outlasts any other type of core used in well-servicing lines. It will save money for you in every USS Tiger Brand Line you buy for this service.



This mark tells you a product is made of modern, dependable Steel.

"USS Tiger Brand line with Petrofiber Core is the best yet for well-servicing"

"We've tried every line that came along for well-servicing and this Tiger Brand line with Petrofiber Core outlasted them all." These are the words of Mr. K. D. Cole and Mr. B. G. Spurgeon who operate seven well-servicing rigs around Wewoka, Oklahoma. Every well-servicing contractor has run up against the problem of shortened wire line life due to core deterioration caused by hole fluids such as acids, caustics, salt water and other elements in the well.

Petrofiber cores are 100% resistant to all hole fluids. They are made with synthetic fibers derived from a new group of petrochemicals: polypropylene by name. This material has superior qualities for cores of swabbing lines, sand lines, and drilling lines when used in well-servicing. The new Tiger Brand Petrofiber line can be stored indefinitely without rotting or aging of the core. It has no tendency to absorb corrosive hole fluids or chemicals.

Provides best strand-supporting characteristics. Petrofiber cores afford a more stable and more lasting support to the line's steel strands. Core flow or migration which can result in unbalancing the line has been eliminated.

Withstands highest well temperatures or arctic cold. Petrofiber cores have an extremely high softening point of almost 300°F. This permits continued operation at higher well temperatures than ever before possible. They also retain full toughness down to *minus* 80°F. They could be used in the Arctic Circle or in the desert without core damage.

Gives longer money-saving service. Wire lines made with Petrofiber cores withstand the most difficult well-servicing operations. They have been proven in the field and will outlast any line you've ever used. Send for our folder on Tiger Brand Lines with Petrofiber Cores. American Steel and Wire, Dept. 1401, Rockefeller Building, Cleveland 13, Ohio. USS, Tiger Brand and Petrofiber are registered trademarks.

American Steel and Wire Division of United States Steel

USS

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, Distributors Abroad

Contractor's Name	Rig No.	Make & Model No. of Unit	How Unit is Transported	No. of Drums	Estimated Capacity		Can Unit Also Drill?
					Swabbing	Pulling	
	33	Wlsn Super 38 w/Derrick 66′	Truck	2	12,000	12,000	—
Midland							
Basin Well Serv Inc	32	Hopper G	Truck	—	10,000	8,000/2″	No
	37	Hopper G	Trailer	—	15,000	12,000/2″	Yes
	38	Hopper G	Trailer	—	15,000	12,000/2″	Yes
	44	Hopper G	Truck	—	12,000	10,000/2″	No
	46	Hopper G	Truck	—	12,000	10,000/2″	No
C H Brockett Inc	3	Crdwll K	Truck	—	—	7,500/2″	No
	5	Crdwll KS	Truck	1	—	10,000/2″	No
	4-6	Wlsn Giant	Truck	1	—	16,000/2″	No
Pool Well Serv Co	18	Wlsn Mogul 42 w/Derrick 90′	Trailer	2	14,000	14,000/2½″	Yes
	22	Wlsn Mogul 42 w/Derrick 90′	Trailer	2	14,000	14,000/2½″	Yes
Mission							
J & M Well Serv	6-B	Wlsn Super	Truck	2	6,000	7,000/2½″	Yes
	10	Cooper Skytop	Self-prop	2	8,500	10,000/2½″	Yes
	11	Wlsn Winchmbl	Self-prop	2	10,000	16,000/2½″	Yes
	12	Wlsn Winchmbl	Self-prop	2	10,000	16,000/2½″	Yes
	15	Cooper T36	Truck	1	10,000	—	No
Monahans							
Pool Well Serv Co	27	Wlsn Mogul 42	Trailer	2	14,000	14,000/2½″	Yes
	34	Wlsn Super 38 w/derrick 90′	Self-prop	2	12,000	12,000	No
White Well Serv	3	AH Crdwll	Trailer	2	9,000	9,000	No
	4	Crdwll K-200	Trailer	2	13,000	13,000	No
	5	Crdwll AH	Trailer	2	9,000	9,000	No
	8	Crdwll K-200	Trailer	2	13,000	13,000	No
	9	Wlkr-Nr	Trailer	2	5,000	5,000	No
	10	Wlkr-Nr	Trailer	2	5,000	5,000	No
	11	Crdwll AH	Trailer	2	9,000	9,000	No
	12	Crdwll AH	Trailer	2	9,000	9,000	No
	16	Frnks 44	Trailer	2	9,000	9,000	No
	21	Frnks 5000	Trailer	1	10,000	10,000	No
	21	Hopper	Trailer	2	13,000	13,000	No
	22	Hopper	Trailer	2	13,000	13,000	No
Nocona							
Jack Mercer Well Serv	2	Wlsn Sr	Truck	1	—	3,000/2″	No
	7	Wichtex C-65	Truck	2	8,000	8,000/2″	Yes
	8	Wichtex E-75	Truck	2	10,000	10,000/2″	Yes
	15	Wichtex E-75	Truck	2	10,000	10,000/2″	Yes
	18	Wichtex E-75	—	2	10,000	10,000/2″	Yes
	20	Wichtex E-75	Truck	2	10,000	10,000/2″	Yes
	33	Wichtex E-75	Truck	2	10,000	10,000/2″	Yes
No Trees							
Kinsey & Ham Inc	2	Crdwll	Trailer	2	15,000	15,000/2″	Yes
Odessa							
Beckman Inc	1	Natl T-20	Trailer	—	8,000	—	Yes
	9	M-CSCO U-15	Skid	—	12,000	—	Yes
	11	Wlsn M-42	Self-prop	2	800	—	Yes
Devonian Well Serv	2	Frnks 658	Truck	2	14,000	14,000	No
	3	Frnks 658	Truck	2	14,000	14,000	No
	6	Frnks 658	Truck	2	14,000	14,000	No
	7	Frnks 658	Truck	2	14,000	14,000	No
	8	Frnks 658	Truck	2	14,000	14,000	No
	11	Wlsn Giant	Truck	2	14,000	14,000	No
Chas J George Inc	10	Frnks 658	Truck	2	13,500	13,000	No
	12	Frnks 658	Truck	2	13,500	13,000	No
	14	Frnks 658	Truck	2	13,500	13,000	No
	16	Frnks 658	Truck	2	13,500	13,000	No
	17	Frnks 658	Truck	2	13,500	13,000	No
	18	Frnks 658	Truck	2	13,500	13,000	No
	19	Wlsn Mogul	Self-prop	2	14,000	--	Yes
	20	Wlsn Mogul	Self-prop	2	14,000	—	Yes
J R Todd Co Inc	1	Frnks 658DTM	Truck	2	13,000	13,000/2″ 12,000/2½″ 10,000/3″	No
	2	Frnks 658DTM	Truck	2	13,000	13,000/2″ 12,000/2½″ 10,000/3″	No
	3	Frnks 658DTM	Truck	2	13,000	13,000/2″ 12,000/2½″ 10,000/3″	No
Williamson Well Serv Inc	3	Frnks 658	Truck	2	13,500	13,500/2½″	No
	7	Frnks 658	Truck	3	13,500	13,500/2½″	No
	10	Frnks 658	Truck	2	13,500	13,500/2½″	No
	11	Frnks 658	Truck	2	13,500	13,500/2½″	No
	14	Frnks 658	Truck	2	13,500	13,500/2½″	No
	15	Frnks 658	Truck	2	13,500	13,500/2½″	No
	17	Frnks 658	Truck	2	13,500	13,500/2½″	No
	18	Frnks 658	Truck	2	13,500	13,500/2½″	No
	23	Frnks 658	Truck	2	13,500	13,500/2½″	No
	24	Frnks 658	Truck	2	13,500	13,500/2½″	No
	30	Frnks 658	Truck	2	13,500	13,500/2½″	No
	31	Frnks 658	Truck	2	13,500	13,500/2½″	No
	32	Frnks 658	Truck	2	13,500	13,500/2½″	No
	34	Frnks 658	Truck	2	13,500	13,500/2½″	No
	36	Frnks 658	Truck	2	13,500	13,500/2½″	No
	37	Frnks 658	Truck	2	13,500	13,500/2½″	No
Perryton							
Beckman Inc	3	MIW	Skid	—	—	7,500/2½″	No
	U-1	Crdwll	Self-prop	2	—	7,500/2½″	No
	U-2	Crdwll	Self-prop	2	—	7,500/2½″	No
	U-3	Frnks 658	Self-prop	2	—	7,500/2½″	No
	U-4	Frnks 65	Self-prop	2	—	7,500/2½″	No
	U-5	Frnks 658	Tandgm	2	12,000	—	Yes
	12	MIW	Skid	—	—	7,500/2½″	No
	17	Wlsn M-42	Trailer	2	—	8,000/2½″	Yes
	19	Wlsn M-42	Trailer	2	—	8,000/2½″	Yes
Pool Well Serv Co	14	Wlsn Super 38 w/derrick 66′	Truck	2	12,000	12,000/2½″	No
	19	Wlsn Super	Truck	1	10,000	—	—
	36	Frnks 658 w/Derrick 90′	Self-prop	2	14,000	14,000/2½″	No
Pettus							
Ballard Well Serv Co	1	Hopper IG FA214	Truck	2	8,500	10,500	Yes
	2	Hopper IG FA214	Truck	2	8,500	10,500	Yes
	3	Wlsn Mogul	Trk	1	—	9,000	No
Carter Well Serv	1	Wlsn Spr	Truck	2	10,000	9,500/2″	No
	2	Wlsn Super	Truck	2	10,000	9,500/2″	No
	3	Wlsn Super	Truck	2	10,000	9,500/2″	No
	4	Wlsn Skytop	Truck	2	10,000	9,500/2″	No
Pleasanton							
J E Hillier	3	Crdwll 250-KM	Self-prop	2	15,000	15,000/2½″	Yes
Refugio							
W M & W Well Serv Co	3	Wlsn Super	Truck	2	6,500	6,000/2″ 5,000/2½″	Yes
Rio Grande							
J & M Well Serv	1-B	Wlsn Super	Truck	2	6,000	7,000/2½″	Yes
	2	Cooper E-563	Truck	2	6,000	5,000/2½″	Yes
	3	Cooper E-563	Truck	2	6,000	5,000/2½″	Yes
	4	Wlsn Spr	Truck	2	6,000	7,000/2½″	Yes
	5	Wlsn Spr	Truck	2	6,000	7,000/2½″	Yes
	7	Wlsn Spr	Truck	2	6,000	7,000/2½″	Yes
	8	Wlsn Sr	Truck	2	6,000	4,000/2½″	Yes
	9	Cooper T-36	Truck	1	10,000	—	No
	14	Wlsn Spr	Truck	2	6,000	7,000/2½″	Yes
Royalty							
Locke Well Serv	1	Wlsn Spr	Truck	2	12,000	12,000	Yes
	2	Hopper	Truck	2	12,000	12,000	Yes
	3	Wlsn Spr	Truck	2	8,000	8,000	Yes
Rule							
Acme Well Serv Co	1	Wichtex C-65	Truck	2	8,000	8,000/2″	Yes
	2	Wichtex C-65	Truck	2	8,000	8,000/2″	Yes
	3	Wichtex C-65	Truck	2	8,000	8,000/2″	Yes
San Angelo							
Pool Well Serv Co	1	Wlsn Spr	Truck	2	10,000	8,000/2½″	No
	4	Wlsn Spr	Truck	1	10,000	—	No
	6	Wlsn Spr w/derrick 66′	Truck	2	10,000	8,000/2½″	No
	26	Wlsn Spr	Truck	2	6,500	5,000/2½″	No
Snyder							
Leon Goswick & Co	7	Wlsn Spr	Truck	2	9,000	9,500/2″ 8,000/2½″	No
	8	Wlsn Super 38	Guyless	—	—	10,000/2½″	No
C E Knight & Co	2	Wlsn Mogul	Truck	1	—	16,000	No
	3	Wlsn Mogul	Truck	1	—	16,000	No
	4	Cooper	Truck	1	—	16,000	No
Stinnett							
Tex Well Serv Co	1	B Erie 36-L	Skid	3	4,000	4,000	Yes
	2	B Erie 36-L	Skid	3	4,000	4,000	Yes
	3	Wichtex	Truck	2	3,500	3,500	Yes
	4	Wlkr-Nr C-33-A	Truck	3	3,500	3,500	Yes
Sulphur Springs							
Dood Emerson Well Serv	1	Cooper	Skid	—	10,000	7,500/2″	Yes
	2	Wlsn Spr	Truck	—	10,000	7,500/2″	Yes
	3	Wlsn Spr	Truck	—	10,000	7,500/2″	Yes
Sundown							
Williamson Well Serv Inc	20	Frnks 658	Truck	2	13,500	13,500/2½″	No
	28	Frnks 658	Truck	2	13,500	13,500/2½″	No
Sweetwater							
Leon Goswick & Co	5	Wlsn Spr	Truck	2	9,000	9,500/2″ 8,000/2½″	No

Contractor's Name	Rig No.	Make & Model No. of Unit	How Unit is Transported	No. of Drums	Estimated Capacity Swabbing	Estimated Capacity Pulling	Can Unit Also Drill?
	6	Wlsn Spr	Truck	2	9,000	9,500/2"	No
	9	Wlsn Spr	Truck	2	9,000	8,000/2½"	No
Pool Well Serv Co	21	Wlsn Spr w/derrick 66'	Truck	2	10,000	8,000/2½"	No
White Well Serv	7	Hopper	Trailer	2	13,000	13,000	No
	18	Frnks 44	Trailer	2	9,000	9,000	No
	23	Hopper	Trailer	2	13,000	13,000	No
Thompsons							
Moore Petroleum Serv	6	Crdwll K-202	Truck	2	10,000	10,000	Yes
Victoria							
Spears Well Serv Inc	1	Wlsn Spr	Truck	2	8,000	8,500/2" 6,500/2½"	Yes
	2	Wlsn Spr	Truck	2	8,000	8,500/2" 6,500/2½"	Yes
	3	Wlsn Spr	Truck	2	8,000	8,500/2" 6,500/2½"	Yes
	4	Wlsn Spr	Truck	1	8,000	—	—
	5	Skytop Wltrwt	Truck	2	8,000	11,000/2" 9,000/2½"	Yes
	6	Skytop Wltrwt	Truck	2	8,000	11,000/2" 9,000/2½"	Yes
	7	Skytop	self-prop	2	—	11,000/2" 8,000/2½"	Yes
Well Serv Inc	1	Frnks	Trailer	1	—	8,500/2"	—
	2	Frnks	Trailer	1	—	8,500/2"	—
	3	Frnks	Trailer	1	—	8,500/2"	—
	4	Crdwll	Trailer	1	8,000	—	—
	5	Skytop	Trailer	2	—	9,500	—
Whiteface							
Gene McCutchin	1	Wlsn	Truck	2	10,000	10,000	Yes
Whitesboro							
Jack Mercer Well Serv	6	Wichtex E-75	Truck	2	10,000	10,000/2"	Yes
Wichita Falls							
McAlister Well Serv	7	Wlsn Spr	Truck	2	7,500	7,500/2"	No
	10	Wlsn Spr	Truck	2	7,500	7,500/2"	No
	20	C-25	Truck	2	7,500	7,500/2"	Yes
	32	Wlkr-Nr	Trailer	3	7,500	7,500/2"	Yes
	42	Wichtex	Truck	2	5,000	5,000/2"	No
	45	Wichtex	Truck	1	—	5,000/2"	No
Windthorst							
Beuford Thompson Prod Maintainers	2	Wichtex C-65	Truck	2	6,500	6,500/2"	Yes
Wink							
Permian Well Serv Inc	1	Crdwll	Skid	2	12,000	12,000/2"	Yes
	2	Wlsn Spr	Truck	2	12,000	11,000/2"	No
	3	Wlsn Spr	Truck	2	10,000	9,000/2"	No
	5	Crdwll	Truck	1	—	5,000/2"	No
	6	Wlsn Spr	Truck	2	10,000	9,000/2"	No
	7	Wlsn Spr	Truck	2	—	12,000	—
United Oil Well Serv Co	1	Crdwll A-151	Truck	—	10,000	9,000	No
	3	Frnks DTM-658	Truck	—	12,500	13,500	No
	4	Frnks DTM-658	Truck	—	12,500	13,500	No
	6	Frnks DTM-44	Truck	—	11,000	10,000	No
	7	Frnks DTM-658	Truck	—	12,500	13,500	No
Winnsboro							
Winnsboro Well Serv Co	F-1	Frnks Rocket	Truck	2	6,500	8,000/2"	No
	F-2	Frnks Rocket	Truck	2	6,500	8,500/2"	Yes
	F-5	Frnks Spr	Truck	1	—	8,500/2"	No
	F-6	Frnks Mdl 5000	Truck	1	—	9,000/2"	No
	W-4	Wlsn Spr	Truck	1	8,500	—	—
Winters							
Pool Well Serv Co	8	Wlsn Sr	Truck	2	6,500	5,000/2½"	No
	16	Wlsn Spr	Truck	2	10,000	8,000/2½"	No
	20	Wlsn Spr	Truck	2	10,000	8,000/2½"	No
	29	Wlsn Spr	Truck	2	10,000	8,000/2½"	No
Young County							
F M Johnson Well Serv	1	Johnson 30	Truck	3	2,500	2,500	Yes
	2	Clark 30	Trailer	3	3,600	3,600	Yes
	3	Clark 30	Trailer	3	3,600	3,600	Yes
	4	Clark 30	Trailer	3	5,000	5,000	Yes
	5	Clark 30	Trailer	3	5,000	5,000	Yes
UTAH							
San Juan County							
S S Reames Well Servng	6	Crdwll M-250	self-prop	—	10,000	—	Yes
Vernal							
Calif Prod Serv Inc	M-3	Hopper G	Trailer	2	10,000	10,000	Yes
WEST VIRGINIA							
Clendenin							
Wm G Simpson Well Serv	4	Wlsn Sr	Truck	2	4,000	3,500	Yes
	5	Wlsn Jr	Truck	2	2,500	2,900	Yes
WYOMING							
Big Piney							
Stafford Well Serv	*79	Frnks 60	Truck	2	8,000	8,000	Yes
Casper							
Galloway Bros	2	Okla Machine & Supply	Truck	1	—	—	No
M E Billings Well Serv Inc	1	Frnks DD Rokt	Truck	2	10,000	13,000/2"	Yes
Capshaw Well Serv Co	1	Crdwll K-200	Truck	2	10,000	10,000	No
	2	Frnks	Truck	2	12,000	12,000	No
	3	Crdwll KM-210	Truck	2	15,000	15,000	No
Cody							
D & S Well Serv	1	Wlsn Spr 38	Truck	2	10,500	12,500	Yes
	2	Wlsn Spr 38	self-prop	2	12,500	15,000	Yes
	3	Wlsn Spr	Truck	2	8,500	8,000	Yes
Wyoming Well Serv Inc	23	Ideco	Truck	1	6,500	4,500/2½"	Yes
	24	Frnks Rocket	Truck	2	10,000	6,500/2½"	Yes
	25	Crdwll K-201	Truck	2	10,000	6,500/2½"	Yes
	30	Crdwll	Truck	1	10,000	6,500/2½"	No
Glenrock							
Dyer Drlg Co	2	U-15	Truck	—	—	—	Yes
	3	Wich C-60	Truck	2	7,000	8,000/2"	—
	4	Failing	Truck	—	4,500	—	Yes
	6	Wlsn Torcair	Trailer	2	9,000	10,000/2"	—
Hot Springs County							
Dyer Drlg Co	1	Natl T-32	Skid	2	6,000	—	Yes
Linch							
Stafford Well Serv	61	Frnks 658-44	Truck	2	13,000	13,000	Yes
	*73	Frnks 658-44	Truck	2	13,000	13,000	Yes
	*81	Frnks 60	Truck	2	11,000	11,000	Yes
	89	Frnks 658-44	Truck	2	13,000	13,000	Yes
Wyoming Well Serv Inc	22	Crdwll	Truck	1	8,000	7,000/2½"	No
Riverton							
Maddux Well Serv	5	Frnks Expl Rokt	Truck	2	11,500	17,280/2"	Yes
	7	Frnks Expl Rokt	Truck	2	11,500	17,280/2"	Yes
Rock Springs							
Maddux Well Serv	4	Frnks Rocket	Truck	2	10,000	10,000/2"	Yes
Thermopolis							
Maddux Well Serv	6	Frnks Expl Rokt	Truck	2	11,500	17,280/2"	Yes
Werland							
Maddux Well Serv	3	Frnks Rocket	Truck	2	12,500	17,280	Yes

Canadian Well Servicing Contractors

Chupp Well Serv Ltd 525A Seventh Ave SW
Calgary Alberta Canada
Flint Rig Co Ltd 5th Fl Natural Gas Bldg Calgary Alberta Canada
Imler Well Serv Genl Delivery Estevan Saskatchewan Canada
Mac Lean Well Serv Ltd Drayton Valley Alberta Canada
Prairie Well Serv Co Ltd Box 4177 Edmonton Alberta Canada
Raines Well Serv Ltd 11166 73rd Ave Edmonton Alberta Canada
Redwell Serv Co Ltd 6530 100 St Edmonton Alberta Canada
Souris Serv Co Ltd Box 1138 Estevan Saskatchewan Canada
Widney Oil & Drlg Co Ltd 6328 104th St
Edmonton Alberta Canada

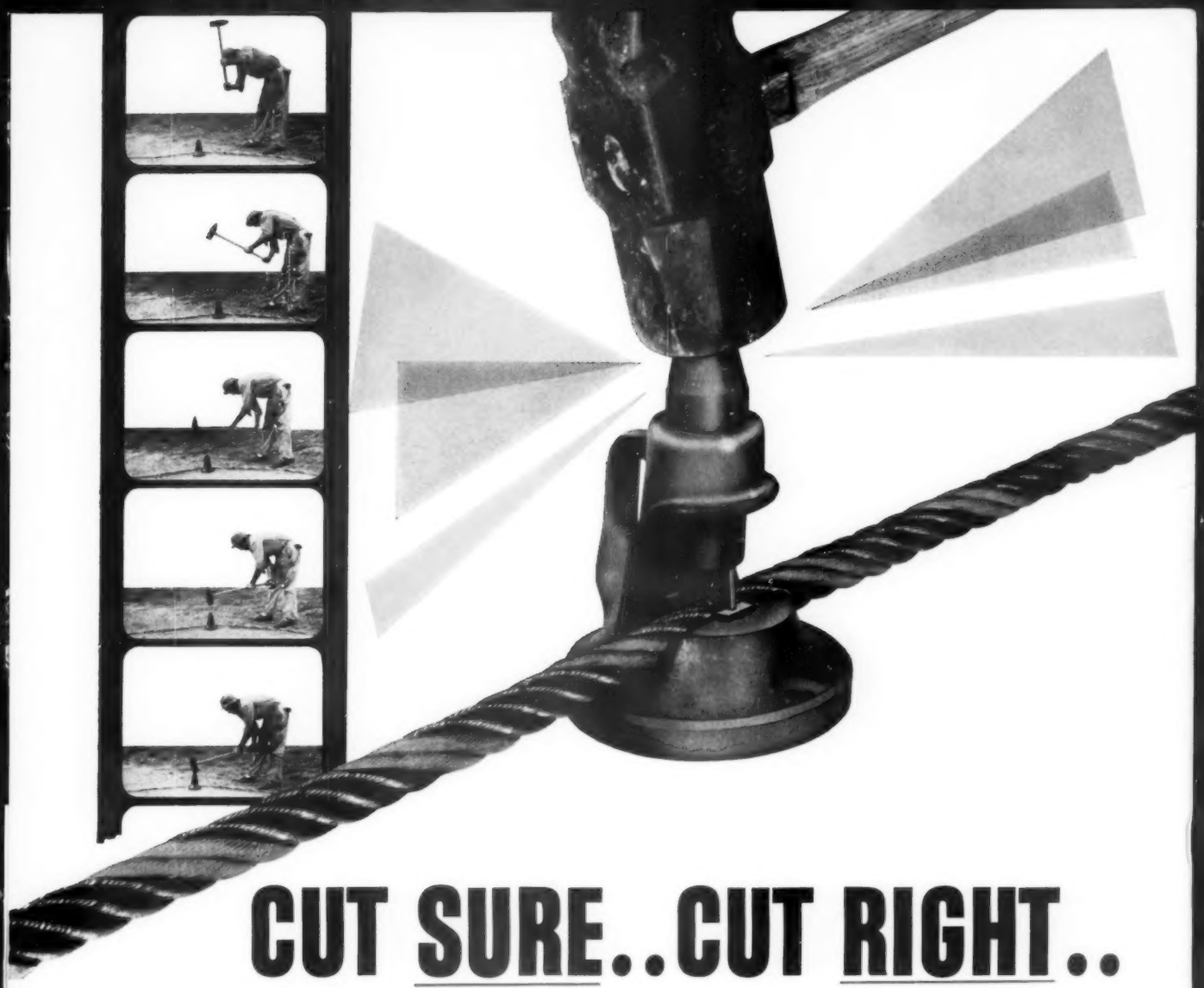
Canadian Contract Well Servicing or Pulling Units

Contractor's Name	Rig No.	Make & Model No. of Unit	How Unit is Transported	No. of Drums	Estimated Capacity Swabbing	Estimated Capacity Pulling	Can Unit Also Drill?
ALBERTA							
Blackfalds							
Redwell Serv Co Ltd	7	Frnks Rokt 44	Truck	2	9,000	9,500/2"	Yes
Breton							
Redwell Serv Co Ltd	1	Crdwll H	Truck	1	9,000	7,000/2"	No
Calgary							
Light Well Serv	101	Ideco M-25	Truck	2	8,500	8,500/2½"	Yes
	115	Frnks Rocket	Truck	2	7,500	7,500/2½"	Yes
	120	Ideco M-25	Truck	2	8,500	8,500/2½"	Yes
	121	Cooper Mdl T	Truck	2	14,000	14,000/2½"	Yes
	122	Ideco H-35	Truck	2	14,000	14,000/2½"	Yes
Comrose Area							
Gamache Well Serv Ltd	2	Frnks Rocket	Truck	2	5,000	4,500/2"	Yes
Crossfield							
Redwell Serv Co Ltd	15	Crdwll K-201	Truck	2	9,000	10,000/2"	Yes
Devon							
Widney Oil & Drlg Co Ltd	9	Wlsn Spr	Truck	2	9,000	8,000/2"	Yes

Contractor's Name	Rig No.	Make & Model No. of Unit	How Unit is Transported	No. of Drums	Estimated Capacity: Swabbing	Estimated Capacity: Pulling	Can Unit Also Drill?
	10	Frnks Rokt 44	Truck	2	9,000	8,000/2" 6,500/2½" 4,000/3"	Yes
Drayton Valley							
Beta Well Serv Ltd	6	Crdwll AH	Truck	2	—	6,000/2" 5,000/2½"	Yes
	8	Crdwll K-201	Truck	2	—	10,000/2" 8,500/2½"	Yes
Mac Lean Well Serv Ltd	1	Crdwll AH	Truck	2	6,500	6,000/2"	Yes
	2	Crdwll AH	Truck	2	6,500	6,000/2"	Yes
	3	Cooper Skytop	Truck	2	10,000	10,000/2"	Yes
Raines Well Serv Ltd	2	Cooper TD	self-prop	2	10,000	10,000	No
Redwell Serv Co Ltd	11	Frnks Rokt 44	Truck	2	9,000	9,500/2" 7,000/2½" 5,000/3"	Yes
	14	Crdwll AL	Truck	2	9,000	7,000/2" 5,000/2½" 3,500/3"	Yes
Widney Oil & Drlg Co Ltd	16	Frnks Expl	Truck	2	9,000	8,000/2" 6,500/2½" 4,000/3"	Yes
Drumheller							
Redwell Serv Co Ltd	6	Crdwll AL	Truck	2	9,000	7,000/2" 5,000/2½" 3,500/3"	Yes
Edmonton							
Jennings Drlg Co (Alberta) Ltd	5	Wlsn Spr 88	Truck	2	12,000	9,000	—
	6	Wlsn Spr 88	Truck	2	12,000	9,000	—
Prairie Well Serv Co Ltd	1	Crdwll H	Truck	1	6,000	6,000/2" 5,000/2½" 4,000/3"	No
	2	Crdwll H	Truck	1	6,000	6,000/2" 5,000/2½" 4,000/3"	No
	4	Ideco 50-60	Truck	2	7,000	7,000/2" 6,000/2½" 5,000/3"	Yes
	6	Crdwll RL	Skid Mtd	2	14,000	14,000/2" 12,000/2½" 10,000/3"	Yes
	9	Frnks	Truck	2	14,000	14,000/2" 12,000/2½" 10,000/3"	Yes
Redwell Serv Co Ltd	13	Crdwll AL	Truck	2	9,000	7,000/2" 5,000/2½" 3,500/3"	Yes
Le Duc Area							
Gamache Well Serv Ltd	3	Frnks Rocket	Truck	2	6,500	8,000/2"	Yes
Lodgepole							
Redwell Serv Co Ltd	10	Frnks Rokt 44	Truck	2	9,000	9,500/2" 7,000/2½" 5,000/3"	Yes
	12	Frnks Rocket	Truck	2	7,000	9,000/2" 7,000/2½" 5,000/3"	Yes
Olds							
Redwell Serv Co Ltd	3	Crdwll H	Truck	2	9,000	7,000/2" 5,000/2½" 3,500/3"	Yes
Red Deer							
Chupp Well Serv Ltd	2	Crdwll RL-709	Trailer	2	—	10,000	—
	2	Ideco M-25-D	Truck	2	10,000	10,000/2"	Yes
	3	Wichtex C-60	Truck	1	5,000	5,000/2"	No
	4	Wichtex C-65	Truck	—	7,500	7,000/2"	No
	5	Ideco M-25-D	Truck	2	10,000	10,000/2"	Yes
Gamache Well Serv Ltd	4	Frnks Expl	Truck	2	8,000	8,000/2½"	Yes
Redwater							
Beta Well Serv Ltd	2	Crdwll H	Truck	1	—	5,000/2" 4,000/2½"	Yes
	3	Crdwll Mobilhst	Truck	2	—	5,000/2" 4,000/2½"	Yes
	11	Crdwll H	Truck	2	—	5,000/2½"	—
	12	Wlsn Super	Truck	2	—	8,000	—
Rimbey							
Widney Oil & Drlg Co Ltd	12	Ideco H-35	self-prop	2	15,000	18,000/2" 15,000/2½" 8,000/3"	Yes
Rocky Mountain House							
Prairie Well Serv Co Ltd	5	Crdwll KL	Skid Mtd	2	15,000	12,000/2" 10,000/2½" 7,000/3"	Yes
Stettler							
Prairie Well Serv Co Ltd	3	Crdwll	self-prop	2	6,500	6,500/2"	Yes
Redwell Serv Co Ltd	2	Crdwll H	Truck	1	9,000	7,000/2" 5,000/2½" 3,500/3"	No
	5	Crdwll AL	Truck	2	9,000	7,000/2" 5,000/2½" 3,500/3"	Yes
Sundre							
Redwell Serv Co Ltd	9	Frnks Clpr 65	Truck	2	9,000	13,000/2" 10,000/2½" 7,000/3"	Yes
Swan Hills							
Prairie Well Serv Co Ltd	11	Cooper	self-prop	2	12,000	15,000/2½"	Yes
Widney Oil & Drlg Co Ltd	1	Ideco H-20	Truck	2	9,000	10,500/2" 9,000/2½" 5,500/3"	Yes
	6	Wlsn Spr	Truck	2	9,000	8,000/2" 6,500/2½" 4,000/3"	Yes
Valleyview							
Widney Oil & Drlg Co Ltd	15	Wlsn Super	Truck	—	10,000	12,000/2" 10,000/2½" 6,000/3"	Yes
Whitecourt							
Redwell Serv Co Ltd	8	Frnks Clpr 65	Truck	2	9,000	13,000/2" 10,000/2½" 7,000/3"	Yes
BRITISH COLUMBIA							
Fort St. John							
Prairie Well Serv Co Ltd	10	Cooper	Self-prop	2	9,000	10,000/2" 9,000/2½" 7,000/3"	Yes
MANITOBA							
Virden							
Flint Rig Co Ltd	55	Wlsn Super 38	Truck	2	8,000	8,000	Yes
	280	Crdwll HS	Truck	1	—	3,600	No
	293	Cooper E-563	Truck	1	—	3,600	No
	307	Frnks 44 DTM	Truck	2	6,000	6,000	Yes
SASKATCHEWAN							
Estevan							
Flint Rig Co Ltd	320	Frnks 44 DTM	Truck	2	6,000	6,000	Yes
	353	Cooper TR 38-38	Truck	2	6,000	6,000	Yes
Kenn Imler Serv Ltd	1	Cooper P-32	Truck	2	5,500	5,500/2"	No
	2	Crdwll H	Truck	2	5,500	5,000/2"	No
	3	Cooper A-32	Truck	2	6,500	6,500/2"	No
Souris Serv Co Ltd	4	Mayhew 2000	Truck	2	5,000	5,000/1"	Yes
Oxbow							
Souris Serv Co Ltd	1	Crdwll AL 50 ft Mast	Truck	2	5,000	5000/2½"	Yes
	2	Frnks Rocket 33 DTD 50 ft Mast	Truck	2	5,000	5,000/2½"	Yes
	5	Mayhew 2000	Truck	2	5,000	5,000/1"	Yes
Widney Oil & Drlg Co Ltd	7	Cooper W-226	Truck	2	5,000	3,000/2½"	No
	8	Wlsn Spr	Truck	2	9,000	8,000/2"	Yes
	11	Frnks Rocket 44	Truck	2	9,000	8,000/2"	Yes
	14	Frnks Rocket 44	Truck	2	9,000	8,000/2"	Yes
Shausavon							
Souris Serv Co Ltd	3	Crdwll AL 50 ft Mast	Truck	2	5,000	5,000/2½"	Yes
Swift Current							
Flint Drlg Co Ltd	290	Crdwll AH	Truck	2	6,000	6,000	Yes
	317	Frnks 44 DTM	Truck	2	6,000	6,000	Yes
	551	Wlsn Supr D D Jr Winchmobile	Self-prop	2	10,000	8,500	Yes
	553	Wlsn Supr DD Jr Winchmobile	Self-prop	2	10,000	8,500	Yes

Foreign Contract Well Servicing or Pulling Units

Contractor's Name	Rig No.	Make & Model No. of Unit	How Unit is Transported	No. of Drums	Estimated Capacity: Swabbing	Estimated Capacity: Pulling	Can Unit Also Drill?
ARGENTINA							
Delta Drlg Co	1	Ideco M-25-D	Truck	2	10,000	10,500/2"	No
	2	Ideco M-25-8	Truck	1	8,500	10,500/2"	No
	3	Ideco M-25-S	Truck	1	8,500	10,500/2"	No
	4	Ideco M-25-S	Truck	1	8,500	10,500/2"	No
	5	Ideco HM-25-S	Truck	1	8,500	10,500/2"	No
	6	Ideco M-25-S	Truck	1	8,500	10,500/2"	No
	7	Ideco M-25-S	Truck	1	8,500	10,500/2"	No



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With such a plan, indicating both *length* of cut-off and *when* to cut, many contractors report up to *30% longer rotary-line service!*

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CONTINENTAL EMSCO

BB102

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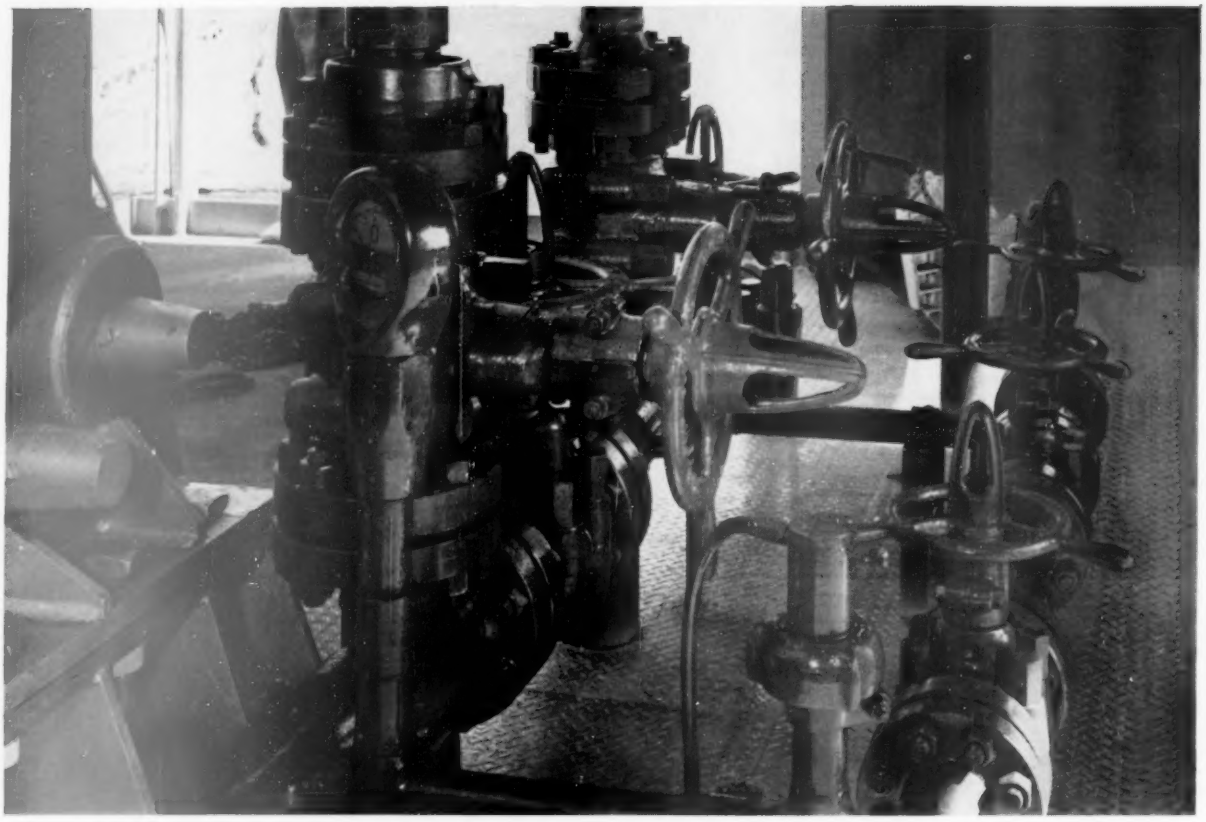

CONTINUOUS LEADERSHIP — CAMERON FLEX-SEAL VALVES

Introduced twenty-one years ago, Cameron Flex-Seal Valves outsell competitive valves year after year for the tough job of handling abrasive fluids at high pressures. For the control of drilling mud, for valve manifolds in well cementing and formation fracturing, operators choose Cameron Flex-Seal Valves for dependability and low maintenance cost.

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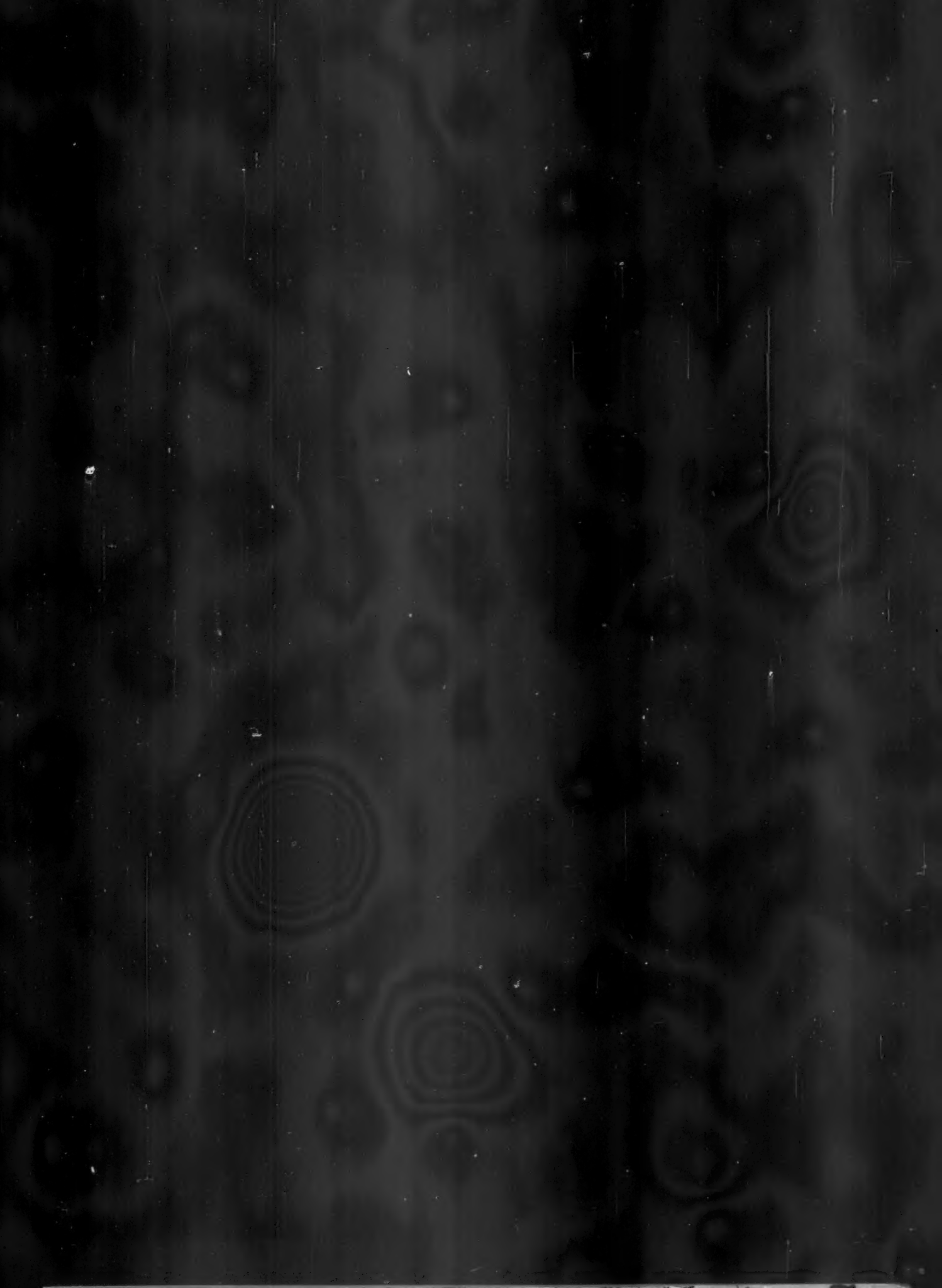
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